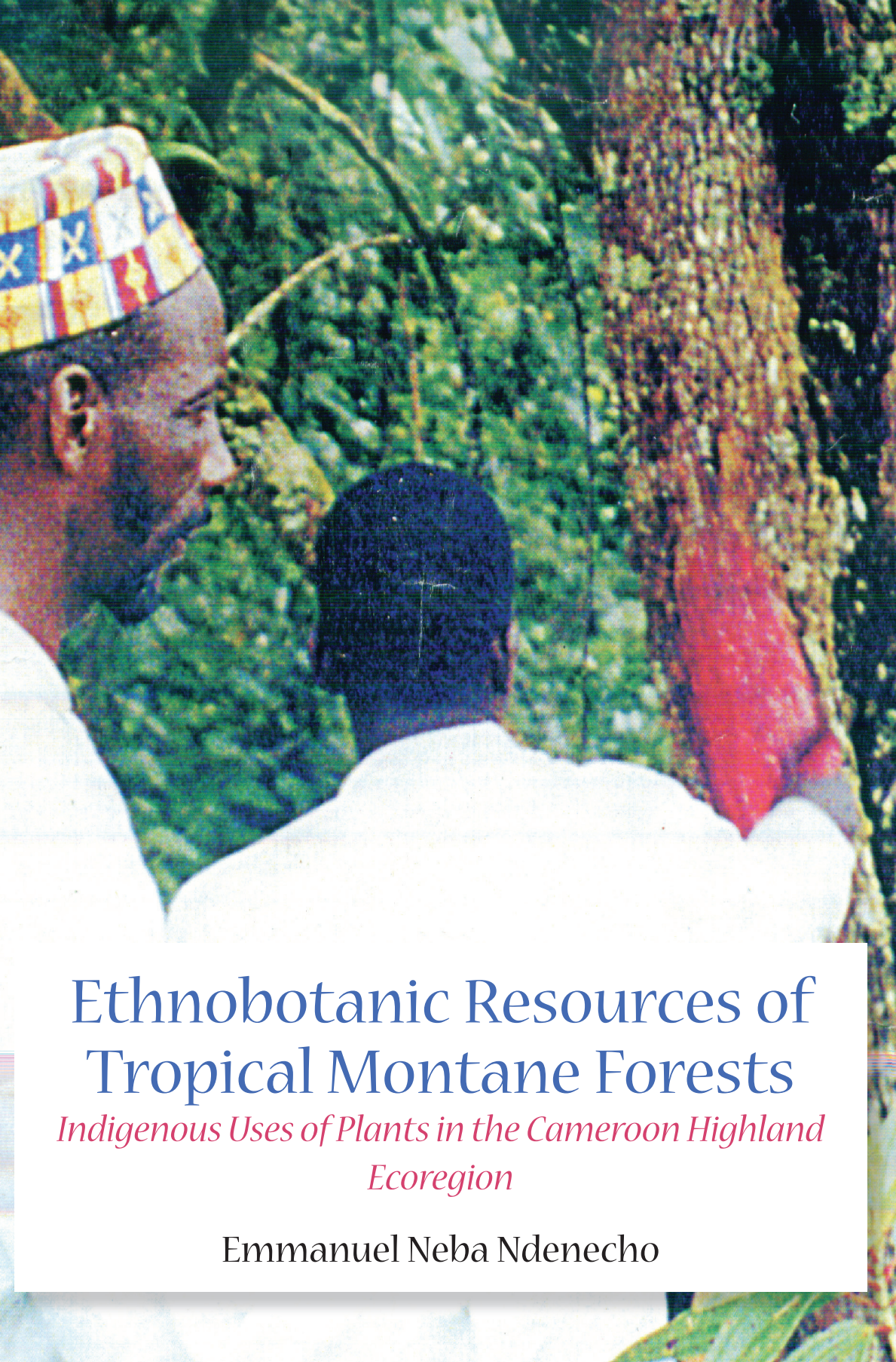




Ethnobotanic Resources of Tropical Montane Forests

*Indigenous Uses of Plants in the Cameroon Highland
Ecoregion*

Emmanuel Neba Ndenecho

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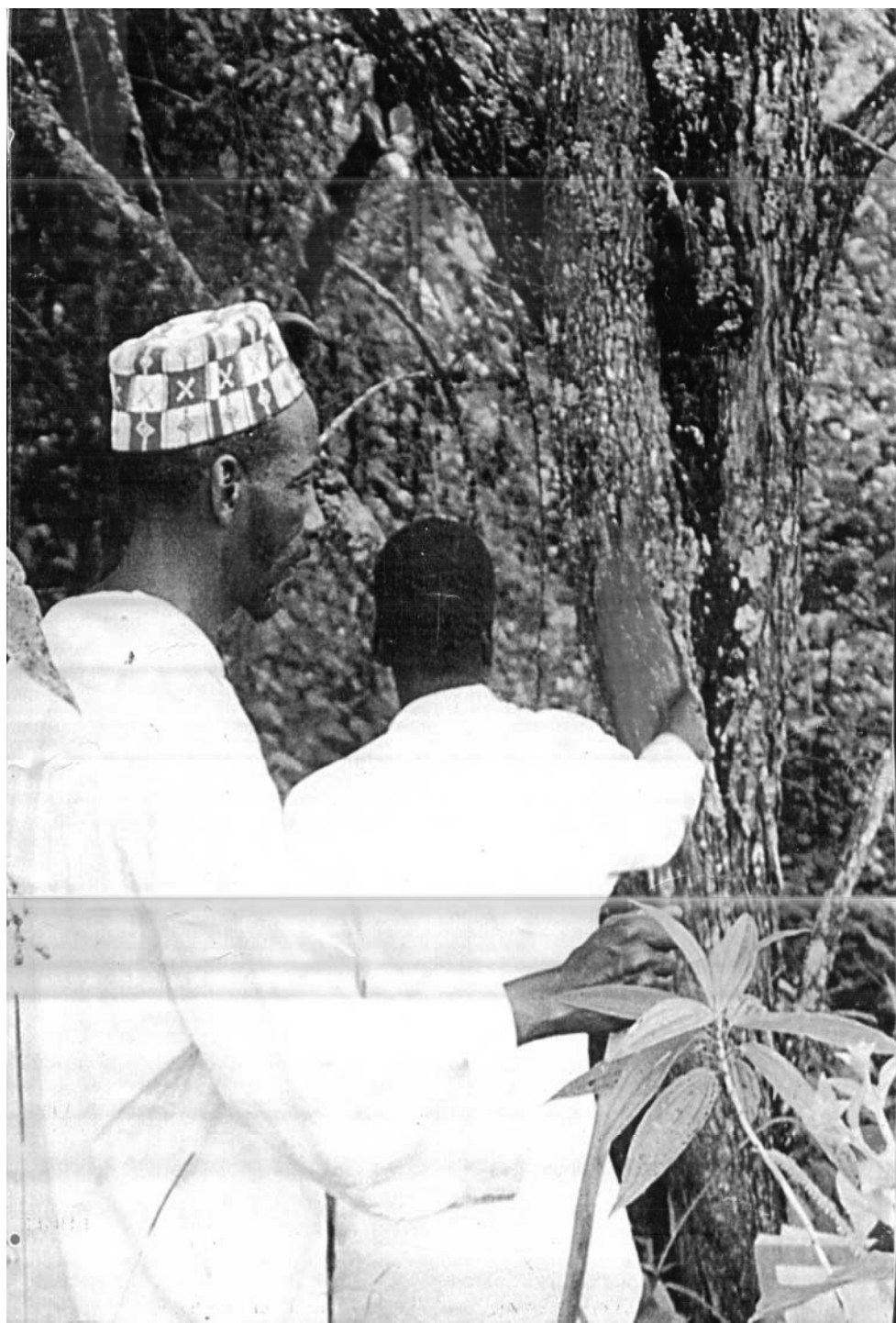
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Epigraph

“All cultures seek to understand nature, but there can be differences depending on the specific ways people use their senses and mind. It is ethnocentric to think that only one particular cultural experience is possible. Understanding the cosmovision of different cultures is a major challenge for the future”

Darshan Shankar and Bertus Haverkost



Dedicated to Mirriam

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Preface

This book puts together case studies of mountain dwellers and indigenous knowledge on useful plants, cultural survival, and plant-dependent livelihoods in mountain areas. It explores new directions in conservation thinking and in protected area management. These new directions start from the premise that mountain dwellers have for millennia been at an ecological balance with available plant and animal resources, that is, the rate of exploitation of these resources was in balance with their natural regenerative capacity. They have long contributed in maintaining biodiversity and ecosystems within their tribal lands. This was achieved by living in ways that left these resources and mountain environments intact, and by resisting outsiders' efforts to take over their lands or exploit their resources. Today, growing populations and the expansion of the modern economy are causing abrupt changes in mountain environments.

Mountain forests are global centres of biological diversity, containing plants and animals that have value for human consumption and medication, provide possibilities for development of pharmaceuticals, and attract tourists. About a quarter of the world's forests are in mountain areas, providing a wide range of goods and services to mountain people, those living downstream, and domestic and foreign visitors. Wood is perhaps the most obvious product of mountain forests – a source of energy, construction materials, fencing and many other products for both mountain people and others.

This book demonstrates that mountain forests are important for many other reasons. At a global scale, perhaps the most important values of mountain forests are their roles in trapping, storing, and releasing water, and protecting slopes and soils from soil erosion. In these ways, mountain forests contribute to the well-being of billions of people worldwide, in ensuring that rivers flowing from the mountains provide reliable and good quality supplies of water. Mountains therefore provide important ecological services.

They also provide goods (products). As a number of case studies in this book make clear, mountain people recognize these diverse values. The book focuses on the importance of mountain forests for the local people who depend most directly on them, and have often developed a wealth of indigenous knowledge on plants and sophisticated institutions for managing limited plant and animal resources. Such knowledge and institutions have often been threatened, or even destroyed, by centralization and globalization; yet there is increasing recognition that community-based institutions are the best adapted to ensuring that mountain forests continue to supply their

diverse goods and services to both mountain and other people over the long-term.

The book provides a useful combination of case studies on ethnobotanic analysis and cultural values of plants, community-based ecological planning for protected area management and eco-cultural tourism development. It provides an unusually useful combination of overviews and synthesis of theory and experience with in-depth case studies of montane forest-adjacent communities and protected areas. Throughout the book there are good summary tables, case study maps, and diagrams that are relevant to the themes in question.

Finally, the book addresses the possible mutual benefits of indigenous knowledge and Western Science, indigenous peoples and the development of eco-cultural tourism in protected areas, indigenous peoples and ecological planning in protected areas. It therefore emphasizes cooperation based on partnerships amongst indigenous people, governments and the global conservation community. Such partnerships must be built on indigenous knowledge, institutions and values attached to flora and fauna. Indigenous people may be well placed and able to cooperate to ensure that partnerships achieve effective conservation.

This is a valuable book for land managers, environmental scientists, environmental biologists, natural resource managers and students reading subjects such as geography, biology, forestry, botany and environmental science.

Ndenecho Emmanuel Neba 2011

Acknowledgments

Born in a mountain environment in Cameroon and after receiving western education I have grown up to appreciate the strengths and to challenge the weaknesses of traditional and cultural heritages. Consequently, I have developed research interest in endogenous knowledge systems, technologies and ethnobotany. Understanding the cosmovision of modern and traditional cultures is a major challenge for anyone working with development. In each situation, the best combination between traditional practices and practices from other parts of the world can be identified through participatory assessment and development. Most of what is documented in this book seeks to enhance this exchange of concepts and approaches between different cultures. Some of the material has previously been published in scholarly journals by the author. These include:

- The Journal of the Cameroon Academy of Sciences, University of Buea, Cameroon.
- International Journal of Environment and Sustainable Development, London, England.
- African Journal of Pharmacy and Pharmacology, Volume 3 (3), Academic Journals.
- Journal of Environmental Sciences, University of Jos, Nigeria.

The author acknowledges with thanks the reproduction of material from these journals. Maps, diagrams and photographs were also reproduced from many authors. The list is too long to reproduce here. The various sources are cited, and an effort was made to trace the copy right holders, but if I have inadvertently overlooked any, I apologize, and will be pleased to make the necessary amendments at the first opportunity.

The documented material, pictures, and diagrams reflect the great diversity of concepts, approaches and practices that still exist related to people, animals, plants, the environment, the culture and religion in various localities. The author acknowledges that this book is a first step to provoke researchers to react, either in support of or challenging certain approaches or positions.

Chapter 1

Mountain Values and Endogenous Knowledge: Challenge for Research and Development

Mountain Values

Mountains span 20% of the landscape of the earth and are home to 10% of humanity. An additional 2 billion people live downstream from them; and depend on their ample water, hydropower, grassland, timber, and mineral resources. Seven of the world's 14 tropical "hotspots" of endemic plants threatened by imminent destruction have at least 50% of their area in tropical mountains (Denniston, 1995). The enormous layers of complexity of mountain landscapes, their climates, vegetation and wildlife have spawned great cultural diversity. For example, several million tribal farmers and pastoralists reside in the mountains of Afghanistan, China, Iran, Nepal, Pakistan and Central Asian nations of the former Soviet Union.

Mountain cultures and ecosystems face three principal threats from the expanding world economy:

- Land scarcity fuelled by inequitable ownership patterns and control of public resources;
- Intensive resource extraction; and
- Mass tourism and recreation.

After millennia of intensive human transformation of the surrounding lowlands, and flat lands, mountains have become vertical islands of cultural and biological diversity surrounded by areas of biologically impoverished landscapes. Mountains are therefore a last opportunity for conserving natural and cultural diversity.

Mountains have for millennia suffered from neglect and marginalization. Except for those whose interest is recreational, scientific, artistic, or religious; mountains exist on the margins of our mental consciousness. As a result of this neglect and marginalization, mountains themselves, their biodiversity, and the people and cultures are vulnerable to environmental, socio-economic and political change. Biologically, their high biodiversity, allows the concentration of endemism, leaves them vulnerable to species loss. Culturally, the fact that most mountain people are ethnic minorities, outside of the dominant cultures of the lowland areas, leaves them in isolation and marginality as guardians of unique and irreplaceable global assets (Roy, 2001). Unfortunately, these assets are under threats of expanding economies. All over the world mountain ecosystems and their species face despoliation and

extinction, and mountain people's livelihoods are threatened by debilitating poverty.

One distinguishing mountain characteristic is fragility or vulnerability to disturbance. Mountain ecosystems are typically less able to recuperate from substantial perturbations such as widespread vegetation loss, and soil erosion. The diversity of wild plants constitutes a global gene bank that is vital to future food security, medicine and craft production. Mountains also function as sanctuaries and refugia for plants and animals long since lost from transformed lowlands.

Because mountains tend to be inaccessible, isolated, marginal lands with challenging environments they have often provided a sanctuary to weak tribal groups escaping from tribal wars. They refuge in mountains as indigenous people and ethnic minorities leaving on the economic margin as nomads, hunters, part-time farmers and foragers, traders, and craft producers. They are therefore the custodians of mountain natural resources and biodiversity. Given the imperative to survive, these people have acquired unique knowledge and skills by adapting to specific constraints and advantages of their fragile, inhospitable environments. They possess millennia of experience in shifting cultivation, tribal craft production, terraced slopes, medicinal use of native plants, migratory grazing, and sustainable harvesting of food, fodder, fuel, and forests.

Finally, sacred places abound in mountains. Mountains evoke deep spiritual and religious meaning or have inspirational appeal. Mountain dwellers despite expanding westernization are deeply attached to forests and other natural mountain splendours. These are places of vital spiritual value for millions of people.

Perhaps, as in a painting, mountains are too often perceived as immutable backdrops to the real world of commerce, industries and complex socio-political activities. The fact that they are isolated, remote, fragile, inhospitable homes to highly complex, overchanging, threatened ecosystems, as well as diverse human cultures, may be inconceivable to those for whom they are "out-of-focus" because of their concentration in the real things in the foreground. This book seeks to create an awareness to mountain values and the indigenous knowledge base of local people. There is a pressing need to refocus on these neglected values and to bring the mountain into the foreground of scientific and public awareness and consciousness. Mountains should be placed more permanently on national and international environmental agendas. The first step in this process is ecologic and socio-economic research necessary to fill in the enormous gaps in knowledge and understanding of the value of biogenetic resources. Mountain people possess this knowledge, hence the need for ethnobotanic studies. This knowledge is

necessary for decision making that can enable their protection and conservation to their rightful place in the global environmental and development agendas.

Montane Forests

The Cameroon Highlands possess a unique flora and fauna, with numerous endemics among the birds and vascular plants. The degree of endemism is believed to have arisen during the Pleistocene age when climate changes forced the forest to retreat to the wetter mountainous areas of the African continent (Figure 1), leaving tracts of forest or “refugia” cut off from one another. Within Cameroon, the most important refugia are thought to have existed in the areas surrounding Mount Cameroon, Mount Kupe and the Bamenda Highlands (Figure 2). The history of the distribution and evolution of montane forest species has been reviewed by Moreau (1966), Hamilton (1976, 1982), Diamond and Hamilton (1980) and Stuart (1986). It is now generally believed that past climatic changes have been instrumental in determining the present distribution of forest species, particularly of birds (Moreau 1966; Hamilton 1976). Prior to 12,000 B. P. the climate seems to have been cold and dry. This must have resulted in the distribution of montane forests in the Cameroon Highlands which were much different from that seen today. Since it was much colder, it is likely that the montane forests were displaced to lower altitudes. Since it was also drier these forests were probably more restricted than they are today (Livingston, 1975; Hamilton 1982). It is generally believed that the wettest places today are likely to be the wettest places during that period (Livingston, 1975). In West Cameroon, the wettest places are Mount Cameroon, Mount Kupe, Mount Nlonako and the Bamenda Highlands (Figure 2). It is therefore likely that montane forests were restricted to these lower mountain slopes during the last glaciation, and became important forest refugia for many montane species of plants and animals.

The restricted and isolated distribution of small populations of montane flora and fauna refugia is believed to have resulted in speciation and subspeciation, since the period of isolation was fairly brief (around 20,000 years before the temperatures rose and the forest expanded). Most differentiation was at subspecies level. Many of the montane forest species have been unable to disperse subsequently from the refugia to colonise other mountains.

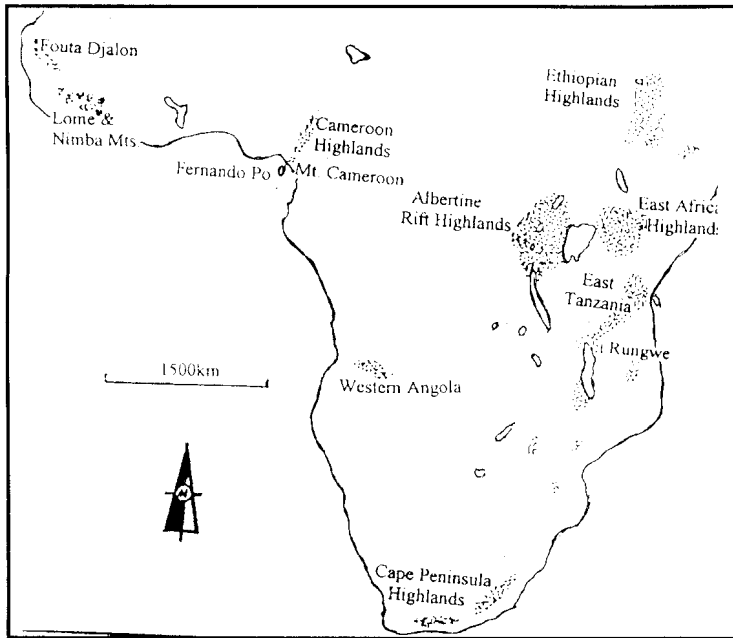


Figure 1: The distribution of Afromontane forest refugia in Africa.

When the climate became much milder and humid, about 12,000 years ago, montane forests were probably displaced up to higher elevations by lowland forest, while increasing humidity made it possible for the forest to expand beyond the refugia to mountains previously too dry to support forest growth. The expansion of the forest could have increased the opportunities of colonization for long distance wanderers. This could explain the disjunct distribution of afromontane vegetation and birds in East and West Africa. Whatever the explanation, the Cameroon Highlands exhibits the western limits of typical members of East African fauna and possess a vegetation with many East African affinities, particularly the *Podocarpus/Arundinaria* formation which is widespread in East Africa, but now found nowhere else in West Africa (Macleod, 1986). The chapter examines the biodiversity features, makes observations on the current status of the forest, the types and severity of threats and establishes how climate change and human-related stresses affect biodiversity. It finally, identifies the scope of mitigating climate change as well as supporting traditional societies in Sub-Saharan Africa in adapting to it.

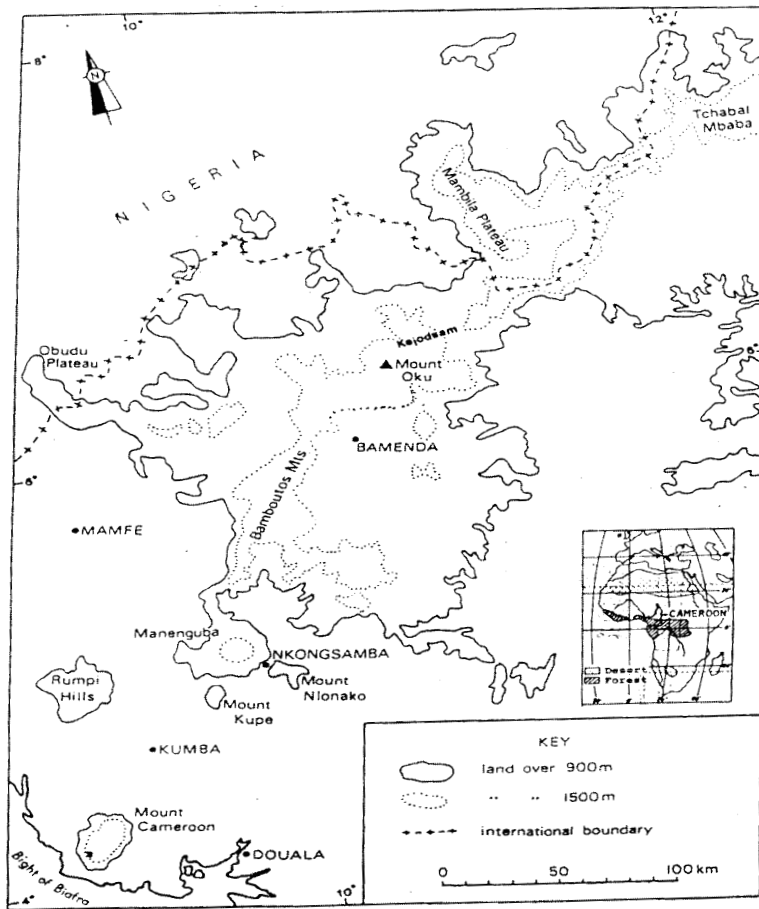


Figure 2: Location of the West Cameroon Highlands.

Geographical Setting of the Ecoregion

Geographically, this ecoregion encompasses the mountains and highland area of the border region between Nigeria and Cameroon, including Mount Cameroon. Most of the ecoregion lies within a narrow rectangle of some 180km by 625km, oriented southwest to northeast and originating from Mount Cameroon. At the southern extremity, the ecoregion covers the Rumpi Hills, the Bakossi Mountains, Mount Nlonako, Mount Kupe and Mount Manengouba. It then extends northeast towards the Mambila Plateau, with an extension north to the Bamenda-Banso highland and outliers northeast to Mambila and northwest to the Obudu Plateau of Nigeria. The main trend of the ecoregion continues north-east along the western flank of

the Adamawa Plateau to Tchabal Gangdaba with two small outliers further east (Stuart, 1986; Gartlan 1989; Stattersfield *et al.*, 1998). The second highest point within this ecoregion is Mount Oku at 3,011m in the Bamenda-Banso highlands. Most of the remainder is below 2,600m in elevation. At about 800m to 1,000m the ecoregion grades into lowland vegetation communities of other ecoregions. In the majority of cases, however, the lower boundary of these forests is now determined by conversion to agricultural land. Although located in tropical Africa the mean maximum temperatures are below 20°C due to the effects of altitude. At the southern extremity, closer to the coast, rainfall is around 4,000mm per annum, declining inland to 1,800mm or less.

These mountains form part of a chain of former volcanoes that stretch inland from the sea. While there are currently no active volcanoes within the ecoregion, the effects of volcanism are still present. Soils derived from these volcanoes are fertile, which makes the land attractive to farmers. Combined with adequate rainfall, this contributes to a high human population density. In White's (1983) phytogeographical classification, these mountain areas fall within the Afromontane archipelago-like regional center of endemism that spans the entire continent. The elevational stratification that occurs along these mountains is quite distinct. Vegetation consists of submontane forests between 900 and 1,800m, and above this a mixture of montane elements, including distinct montane forests and patches of montane grasslands, bamboo forests and subalpine communities. Five species of tree characterize the forested montane zone: *Nuxia congesta*, *Podocarpus latifolius*, *Prunus africana*, *Rapartzia melanophloeos*, and *Syzygium guineense bamendae*, and these trees become increasingly covered with an epiphytic flora, especially orchids and mosses, at high altitudes. Other important montane species include *Crassocephalum mamni*, *Hypericum lanceolatum*, *Myrica humilis*, *Pilippia mannii*, *Schefflera abyssinica*.

Observations on Biodiversity Features

Although plant diversity and biogeography are poorly known, tree species diversity tends to be low, but the diversity of non-woody plants such as grasses is high. Highest levels of tree endemism are found in the submontane region and the higher elevations of the adjacent Mount Cameroon (Figure 2) ecoregion. Overall tree diversity, however, decreases with increasing elevation. There is also a significant endemic flora in the grasslands, heathlands, moorlands and other non-forested habitats at higher elevations. These non-forested habitats share elements with the high mountain plant communities to the east, namely the Ruwenzori-Virunga montane moorlands. The Cameroon Highlands ecoregion is not high enough

to contain pure Afroalpine elements, which are restricted to the highlands of East Africa (Figure 1).

The forests have affinities with the highland forests of Angola on the southern fringes of the Congo Basin (Kingdom, 1990) and especially with forests in East Africa. Most of the trees in the montane forests of Cameroon are also present in the mountains of eastern Africa; some examples include: *Alangium chinense*, *Albizia gummifera*, *Apodytes dimidiata*, *Cassipourea gummiflua*, *Croton macrostachyus*, *Ilex mitis*, *Olea capensis*, *Podocarpus latifolius*, *Polyscias fulva*, *Prunus africana*, *Schefflera abyssinica*, *Strombosia scheffleri*, *Xymalos monospora*, and at edges *Agauria salicifolia*, *Maesa lanceolata*, *Myrica humilis*, *Nuxia congesta*, *Pittosporum virid*, *Ulorum*, *Rapanea melanophloeos* and *Scolopia zeyheri* (Dowsett-Lemaire, 1989). The liane *Dregea schimperi* (Asclepiadaceae), common in the drier type of montane forests of this ecoregion is widespread in the mountains of East Africa (Thomas and Thomas, 1996).

The Mount Cameroon region in terms of climate has been described as the equatorial types of monsoon (Moby, 1979). It is characterized by 1 to 3 dry months and the annual rainfall ranges from 10,000mm in the South – Western Slopes of Mount Cameroon to 2,000mm in the northern parts. The annual average temperature is variable. In the coastal areas it is 2.8°C. The highland areas have an annual average temperature of 21°C with a temperature range of 2.2°C. The vegetation can be classified as lowland rainforest of the Guinea-congolian type (White, 1983). This vegetation type forms the refuge into which the rainforest was reduced during the Pleistocene (Gartland, 1986; Hamilton, 1976). See Table 1 and figure 2.

In terms of biodiversity, the biota is very rich and varied in endemic species. From the sea to an impressive altitude the area is covered by one of the richest forests in West Africa. Mount Cameroon dominates the area and is unique for two reasons (Ewane, 2001):

- It is the only area in West Africa which presents a complete, uninterrupted vegetation gradient, from the coast through Mountain forest, savanna and the alpine vegetation at 4,095metres above sea level.

- The rich volcanic soils have occasioned dense rain forests with the following outstanding aspects:

- 50 endemic plant species
- 30 near endemic plant species
- 20 endemic bird species (8 of which are threatened)
- 5 primate species (three of which are endemic)
- The presence of the highly endangered forest elephant.

Table 1: Vegetation types of Bamboko Forest Reserve and their main characteristics

N ^o	Vegetation type	Elevation (M)	Main characteristics
1	Lowland Rainforest	0 – 800	Species – rich, evergreen forest with tall continuous canopy (25 – 35m) and large emergent trees rich in lianas and woody climbers
2	Lower montane (or Sub-montane) Rainforest, elephant bush	800 – 1600	Species – rich, evergreen forest with closed or discontinuous canopy (20 – 25m), frequently cloud covered, very rich in bryophytes, ferns and vascular epiphytes.
3	Upper montane (or Montane) Rainforest	1600 – 1800	Species – poor, open forest with discontinuous canopy of medium sized- trees (up to 20m high), large stranglers, dense epiphyte cover and few climbers.
4	Sub-alpine Rainforest (or montane scrub)	1800 – 2400	Species – poor, poorly developed open forest with discontinuous canopy of small- sized trees (1 – 15m), and open layer of small shrubs, herbs, climbers and ferns underneath in fire protected hollows.
5	Montane Grassland	2000 – 3000	Species – poor, rich in temperate genera, dominated by tall tussock grasses, with scattered stunted and dwarf shrubby fire resistant trees.

6	Sub-alpine Grassland	3000 – 4095	Species – poor, dominated by short tussock grasses, with isolated patches of dwarf and gnarled shrubby trees and thick ferns and lichens.
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Source: Effange, 2006

These species are all vulnerable or endangered. These forests were once widespread but have been extensively cleared. The biodiversity characteristics can be grouped as follows (Thomas, 1986):

- **Narrow or strict endemics:** These are more restricted in their range. They are highly vulnerable and are endangered. They are therefore of high conservation priority. Because they are restricted to relatively small areas with usually comparatively small individuals, narrow endemics are more easily rendered extinct than more numerous widespread individuals. A typical example is the *Afrothyismia pachyantha* which is endemic to Moliwi at the foothills of Mount Cameroon. The current conservation philosophy of the conservation projects in the region is to concentrate resources in protecting such areas.

- **Near endemics:** These are species that occur at a site and at one or two places nearby. For example, of the 50 near endemic species of Mount Cameroon, 29 are also found at Bioko (Fernando Po) and others in the Bamenda Highlands. Mount Cameroon alone has 42 strictly endemic species found only on the main massif. It has 50 near endemic species. Most of these endemic species are located either in high altitude grasslands or in the ecotone (forest grassland boundary) (Cheek, 1992). See Figure 3

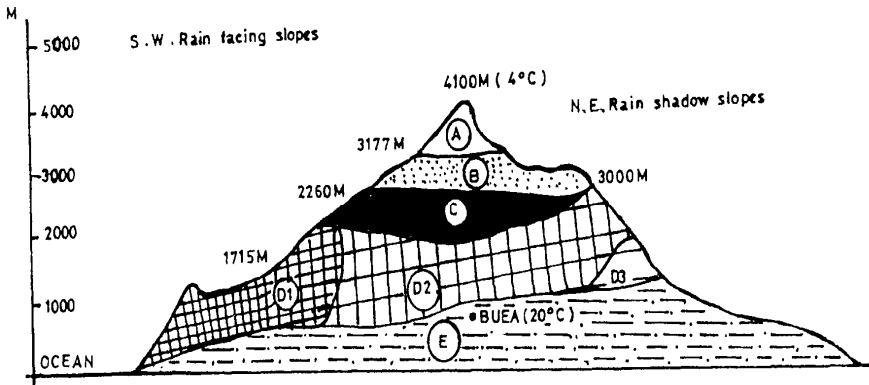


Figure 3: Degradation of the main massif: Mount Cameroon Forest: A = rock land, B = Subalpine grassland, C = Montane Forest, D1 = Rain Forest, D2 = Partially degraded rainforest in foothill zones where there are paleoendemics, D3 = Fragmented rainforest, E = Industrial tree crops / food crop plantations.

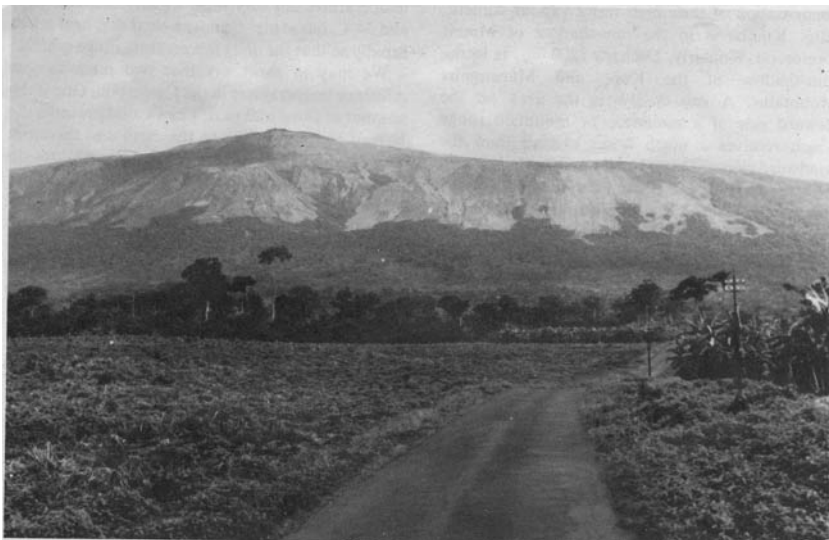


Photo: Mount Cameroon: Paleo-endemic plants at the foot of the mountain have been degraded by agro-industrial plantations.



Photo: Degraded montane forest on the slopes of Mount Manengouba: Slash – and – burn shifting cultivation and the extraction of timber and non-timber forest products are important livelihood activities (Photo IGN)

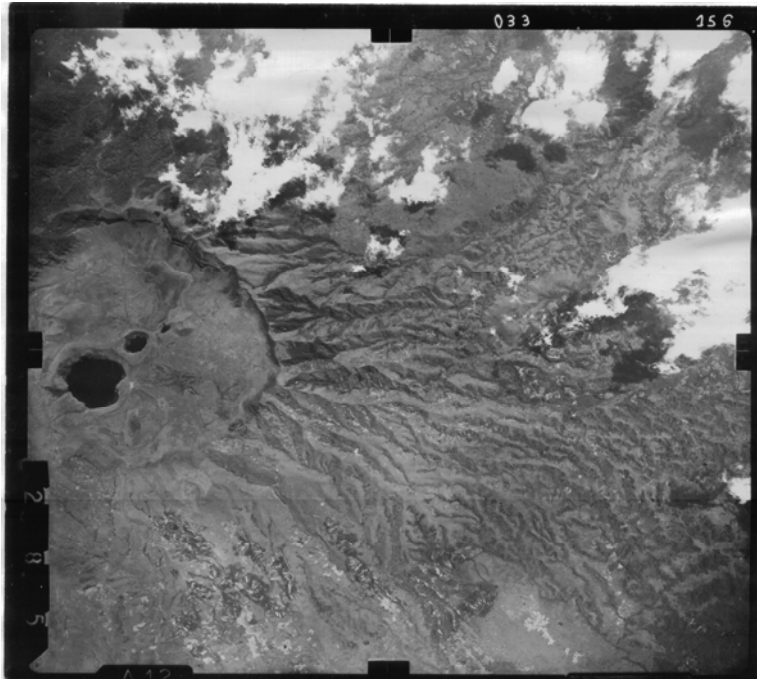


Photo: Mount Manengouba showing refugia of montane forest in valleys
(Photo IGN)

According to age endemic species are divided into two groups:

- **Neo-endemics:** These are species of limited distribution and of biologically recent origin, and are at the beginning of their evolutionary life. Their parent species may occur close by or at least can be identified. These constitute a majority of the high altitude endemic species of the region (Anon, 1992). Their closest relatives are Europeans or East African montane species. These probably arrived by long-distance dispersal relatively recently and in isolation from their parent population and have undergone genetic drifts. For example, *Succisia trichotocephala* (*Dispsacaceae*) has as its nearest relative's European species. The neo-endemics dominate the lower altitude forest and account for the high level of endemism. Unfortunately, the lower altitude forests are rapidly being degraded for agricultural purposes.

- **Paleo-endemics:** These are species of biologically ancient origin. They are regarded as being at the end of their evolutionary life and often have no obvious parental species. They are evolutionarily isolated and genetically unique. According to Sosef (1994) these are dominated by the Monotype genera which contain species so isolated genetically that they are accorded generic status. These are therefore of very high conservation priority. These

are found mainly on the foothill areas of Mount Cameroon. Examples include: *Neoschumannia discleiadaceae* in Man O'war Bay, *Oxygne burmanniaseae* in Moliwe and *Medusandra (Medusandraceae)* in South Bakundu, Kumba, North Korup, Mamfe, Mabeta and Bamenda. These foothills and surrounding forests have been greatly degraded by slash – and – burn agriculture and agro-industrial plantations (Mesumbe, 2001).

Mount Cameroon has 42 strictly endemic species (on existing data) and 50 near endemics, that is, those also occurring in Mount Kupe. Mount Kupe on its part has 32 strictly endemic species (Cabble, 1994), 29 of the 50 Mount Cameroon near endemic species also occur in Bioko. Concrete examples of flowering plants and ferns strictly endemic to the main massif of Mount Cameroon include the following amongst a host of others (Table 2and 3).

Table 2: Strictly endemic flowering plants and ferns of South West Cameroon

FAMILY	GENUS AND SPECIES
<i>Acanthaceae</i>	<i>Isoglossa nervosa</i>
<i>Araceae</i>	<i>Chlorophytom deistelianum</i> Engl
<i>Begoniaceae</i>	<i>Begonia hookeriana</i> Gilg ex Engl
<i>Boraginaceae</i>	<i>Myosotis s.p. or Vestergrenil</i> stroh
<i>Compositae</i>	<i>Crepis Cameroonica</i> Babe. Ex Hatch. & Dalz
<i>Cyperaceae</i>	<i>Burbostylis densa</i> (wall) Hand – Mazz
<i>Flacourtiaceae</i>	<i>Camptosylus Ovalis</i> (oliv) chip
<i>Graminaceae</i>	<i>Deschampsia mildbraedii</i> Pilger <i>Sporobolus montanus</i> Engl.
<i>Iridaceae</i>	<i>Hesperantha alpinan</i> (Hook. F.) pax ex. Engl
<i>Myrisinaceae</i>	<i>Afrardisia Oligantha</i> Cnlg. and Schellenb
FERNS	
<i>Splemaceae</i>	<i>Splenium adamsii</i> Alston
<i>Teridaceae</i>	<i>Teris preussi</i> Hieron

Source: Limbe Botanical Garden, 2005

Of this taxa, 19 are restricted to the grassland or forest/grassland boundary. They occur nowhere else out of the mountain. The near endemic species seem to appear only on Mount Cameroon and nearby localities,

which include mainly parts of the Western Highlands. As such, only those linking Mount Cameroon and other highlands of West Cameroon are considered here.

Table 3: Near endemics of South West Cameroon

FAMILY	GENUS AND SPECIES	OTHER SITES
<i>Aristolochiaceae</i>	<i>Pararistolochia preussi</i>	Barombi, S. Bakundu forest
<i>Asclepiadaceae</i>	<i>Baresanthus purpureus</i> monotypic genus	Bamenda Highlands, Mabeta – Moliwe
<i>Labiatae</i>	<i>Plectrantus</i> dissitiflorus	Buea to Bimbria
FERNS		
<i>Oleandraceae</i>	<i>Arthropteris</i> Cameroonensis	Limbe

Source: Limbe Botanical Garden, January 2005

Others: endemic to the region but with no specific sites include:

- Bright scarlet flower (*Scadoxus connabarina*)
- King stick (*Prunus africana*) Mount Cameroon
- Purple and white flowers (*Clerodendron*) around Mount Cameroon

With regards to animals, the following is a list of some endemic mammals found in the region (IUCN, 1979). Letter (E) denotes endangered species.

Table 4: Some endemic mammal fauna found in South West Cameroon

TYPE	SCIENTIFIC NAME	MAIN AREA FOUND
Drill (E)	<i>Mandrillus leucophaeus</i>	Rain forest of S. W. Cameroon
Mandrill (E)	<i>Mandrillus sphinx</i>	Mt. Cameroon; rain forest south of river Sanaga
Chimpanzee (E)	<i>Pan troglodytes</i>	Woodland savanna and mountains up to

		2500m
Preuss Monkey (E)	<i>Cercopithecus preussi</i>	Rainforest and montane forest up to 2500m
Gorilla (E)	<i>Gorilla gorilla</i>	Rain forest
Dwarf crocodile	<i>Osteoleomus tetraspis</i>	Ponds, small streams
Nile crocodile	<i>Crocodylus niloticus</i>	Rivers, ocean
Red eared monkey (E)	<i>Cercopithecus orythrotis</i>	Mount Cameroon
Red colobus monkey (E)		Korup
Red capped mangabey	<i>Cercocebus taquatus</i>	Rain forest
Elephant (T)	<i>Loxodonta africana cyclotis</i>	Mount Cameroon around West Coast; Bamboko

Key: E = endangered species, T = Threatened species

Source: Limbe Zoological Garden, January 2005

Cameroon has been identified by the World Bank, World Wildlife Biodiversity Task force and the International Union for Conservation of Nature and Natural Resources as one of the 13 mega diversity countries of the world. As a consequence the government of Cameroon has established protected areas in the study area. These are areas protected to maintain nationally significant landscape characteristics of the harmonious interaction of resident people and land while providing opportunities for recreation and tourism (Asong, 2001).

The ecoregion contains exceptional levels of avian endemism. There are seven strictly endemic bird species, the Bamenda apalis (*Apalis bamendae*), Bangwa forest warbler (*Bradypterus bangwaensis*), whitethroated mountain-babbler (*Kupeornis gilberti*, EN), banded wattle-eye (*Platysteira laticincta*, EN), Bannerman's weaver (*Ploceus bannermani*, VU), Bannerman's turaco (*Tauraco bannermani*, EN) and Mt. Kupe bushshrike (*Telophorus kupeensis*, EN) (Bowden and Andrews 1994, Stattersfield *et al.* 1998). An additional nine montane endemics in common with Mt. Cameroon and Bioko, these are *Psalidoprocne fuliginosa*, *Andropadus tephrolaemus*, *Phyllastrephus poensis*, *Phylloscopus herberti*, *Urolais epichlora*, *Poliolais lopezi*, *Nectarinia oritis*, *Nectarinia ursulae*, *Nesocharis shelleyi*. There are also 14 species in common with just Mt. Cameroon and not

Bioko, adding *Andropadus montanus*, *Phyllastrephus poliocephalus*, *Laniarius atroflavus*, *Malacotus gladiator*, *Cosypha isabellae* and the race *Cisticola chubby discolor* (sometimes considered a separate species *C. discolor*) (Dowsett 1989, Dowsett-Lemaire and Dowsett 1989, 2000, Fotso *et al.* 2001).

Eleven small mammal species are considered strictly endemic to this region: Eisentraut's striped mouse (*Hybomys eisentrauti*, EN), an African wood mouse species (*Hylomyscus grandis*), Mount Oku mouse (*Lamottemys okuensis*, EN), Mittendorf's striped grass mouse (*Lemniscomys mittendorfi*, EN), two (*Lophuromys dieterleni* and *L. eisentrauti*), Oku mouse shrew (*Myosorex okuensis*, VU), Rumpi mouse shrew (*M. rumpii*, CR), western vlei rat (*Otomys occidentalis*, EN), Hartwig's soft-furred mouse (*Praomys hartwigi*, EN), and Isabella's shrew (*Sylvisorex isabellae*, VU). In addition to these smaller species, there is also an isolated population of an endemic subspecies of lowland gorilla (*Gorilla gorilla diebli*, EN). There are also populations of rare larger mammals – for example, there are several groups of drill (*Mandrillus leucophaeus*, EN), in Bakossi, as well as healthy populations of Preuss's red colobus (*Procolobus pennanti preussi*, EN) and chimpanzee (*Pan troglodytes*, EN). One large group of drill was seen on Mount Kupe as recently as 2000.

Very high levels of endemism are observed among amphibians, with nearly 40 species as strict endemics (Gartshore in Stuart, 1986): *Hylarana longipes*, *Petropedetes parkeri*, *P. perreti*, *Phrynobatrachus cricogaster*, *P. steindachneri*, *P. werneri*, *Phrynobatrachus* sp. (Oku), *Phrynodon* Sp. 1 *sensu* Amiet (1975), *Phrynodon* sp. 2 *sensu* Amiet, *Arthroleptis adoifriedericii*, *Cardioglossa melanogaster*, *C. oreas*, *C.*

Among the reptiles the following nine species are considered narrow and endemics: *Atractapsis coalescens*, *Chamaeleo eisentrauti*, Pfeffer's chameleon (*C. pfefferi*), four-horned chameleon (*C. quadricornis*), *Cnemaspis gigas*, *Leptosiaphos chriswildi*, *L. ianthinoxantha*, angel's five-toed skink (*L. lepesmei*) and *Panaspis duruvarum*. In addition to the narrow endemics, there is also a significant overlap between the flora and fauna of this ecoregion and that of the nearby Mount Cameroon and Bioko Montane Forests ecoregion. Fifty near endemic plant species are shared between the two ecoregions. Similarly, 27 bird species are confined to these two ecoregions (Stattersfield *et al.* 1998). A similar pattern of overlap in taxa is seen in the plants, birds, reptiles, amphibians, invertebrates and small mammals.

The Current Montane Biodiversity Status, Types and Threats

While the different mountains and highlands that comprise this ecoregion are naturally geographically isolated, human activities are increasingly fragmenting, degrading and isolating the remaining forest patches. The area around Mount Oku in the Bamenda-Banso Highland

supports some 100km² of forest, and there are other patches in this region. The Bakossi Mountains have at least 200km² of mid-altitude and montane forest above the altitude of 1000m; and the lowland forest ("Western Bakossi") covers some 400km². The Mt. Nlonako Faunal Reserve also contains a partial forest continuum from the montane section to the lower levels, Tchabal Mbabo, in the northern sector, has almost 50km² of virtually pristine montane forest (Thomas and Thomas, 1996). In Nigeria, the biggest patch in the Gotel Mountains covers 46km² (peak Gangirwal) and there are other patches. Montane forest remnants also remain in gullies of the Obudu Plateau and on the highland areas further to the north such as the Mambila and Mana Plateaux and Gashaka Gumti; all are smaller than the Cameroon patches (Sayer *et al.* 1992, Stattersfield *et al.* 1998).

Forest loss has been significant on many mountains in this ecoregion. Much of the Bamenda-Banso Highlands were once covered by forest, but the cover has declined by more than 50% since the 1960s through conversion for cultivation, because of the relatively fertile soils and the reliable rainfall in this area (Stuart 1986, Collar and Stuart 1988, Alpert 1993). Similarly, deforestation has also occurred on the Obudu Plateau.

This is one of the least well-protected ecoregions in Africa. No part of this ecoregion is under formal protection status in Cameroon, although local traditional rulers still exert considerable authority over land use. The main section of Bakossi (550km²) has been proposed as "Protection Forest", banning all logging. Kupe has been proposed as a "Strict Nature Reserve", and the boundaries of this reserve were successfully delineated with the participation of the local people in 2000 – 2001. The Kilum forest at Oku has some form of protection and the boundaries are well demarcated; unfortunately, the demand for firewood for neighbouring towns (including Bamenda) is so high that the forest may not have a long-term future. Nlonako Mountain is a Faunal Reserve, which gives it protection from logging, even if the hunting ban is not respected. In Nigeria the Gashaka Gumti National Park contains some montane forest and some fragments remain at Obudu in the Okwangwo section of the Cross River National Park.

The natural habitats of this ecoregion are highly threatened and are being lost through conversion to agriculture, unsustainable use of timber, fires from farmland, and the collection of firewood and construction materials (Collar and Stuart 1988, Gartlan 1989, Alpert 1993, Blom *et al.* in prep). Because volcanic rock produces good soils, there is considerable pressure to convert such volcanic areas to farmlands. However, these soils also dry easily, leading to desiccation during the dry season. Unsustainable collection of *firewood is a major cause of degradation of forest patches*. Hunting also threatens the remaining large mammals.

Several plants and animals are used for food in traditional communities. Diversity is key to nutritionally adequate diets. Adaptation to changing conditions due to climate change is better achieved through diversification, reducing the negative impacts of extreme events, like floods, droughts, or diseases. In general, wild sources of food remain particularly important for the poor and landless and play a very significant role in times of famine, and insecurity and conflict, when food supply mechanisms are disrupted and people have limited access to food. Traditional communities are also highly dependent on ethnopharmacology. Several medicinal plants have been identified by the Limbe Botanic Garden. Biodiversity contributes not only directly to food security, but also to a number of environmental services provided to agriculture, such as pollination of food crops, water regulation, disease control and others. Intact ecosystems are important sources of local livelihood. Biodiversity also serves as a safety net for vulnerable households in time of crisis because it offers income opportunities, and sustains productive agricultural ecosystems. Development actions must focus on the functional relationships and processes within ecosystems. A key question is how local livelihood improvement and food security can be linked to biodiversity conservation and land management in the buffer zones of protected areas.

In most traditional cultures people believe that, to maintain the health and vitality of human beings, animals, plants and environments, they have to address forces in both the natural and the spiritual world. Practitioners of western-based science tend to look down on indigenous knowledge systems. This has resulted in serious erosion of traditional practices over the past decades. This is because western science is the dominant economic and political culture in most parts of the world. It tends to ignore what it cannot understand and demands validation based on its own logical framework. Though the technical rationale of traditional practices may not always be clear to outsiders, one need not insist on knowing the rationality behind each particular practice. Attempts at validation of traditional practices should rather concentrate on observing their results under prescribed circumstances and conditions. Documenting traditional knowledge and publishing it in the public domain may lead to improvements in traditional and modern practices in agriculture, nutrition and health. Exchanging concepts and approaches between cultures may lead to improvements in traditional and modern practices in health and agriculture. Ethnobotanical studies are important in fostering this scientific dialogue between cultures. Mountain people and their cultures possess enormous knowledge on plant uses.

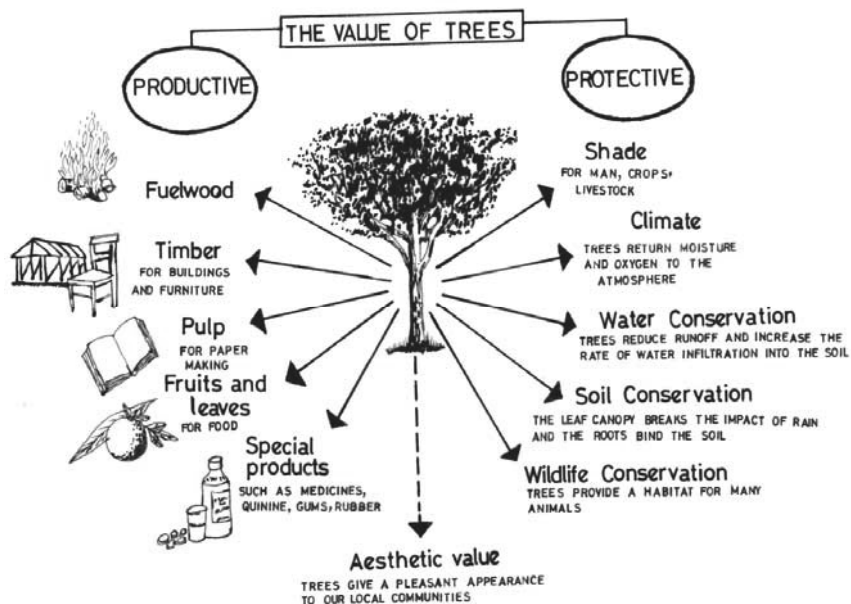


Figure 4: The value of trees

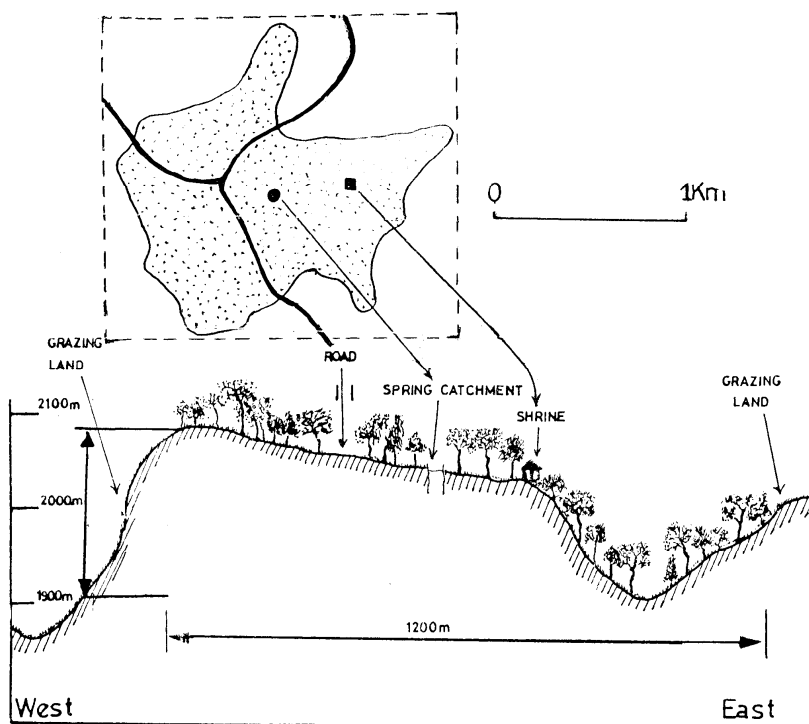


Figure 5: Degradation of Mbiame Forest Refugia (Bui)

Local Values: A Challenge for Research

Many decisions taken during the process of planning conservation interventions in tropical forests are influenced by scientists and politicians. Although local people may be strongly affected by these decisions, there are problems related to external professionals' understanding of how such decisions might affect the livelihoods of local people dependent on biodiversity resources. The problem is that different interest groups use different concepts to guide them, and these in turn are associated with different sets of values. The idea of biodiversity is now considered by scientists to be the most important factor influencing conservation initiatives. However, this is a concept invented by scientists and we cannot expect local residents to share it. This is particularly important because biodiversity conservation cannot ignore local livelihoods. There is need for research action geared at exploring local values for forests and plants. Therefore, one of the most urgent challenges faced by scientists and social research in conservation is to understand how the values local people associate with forests, forest plants and animals relate to the scientific concept of biodiversity conservation. Perhaps it is even more urgent to explore ways of conducting such research. Mountains are particularly valuable for this type of investigation, as they are characterized by a wide range of distinctive ecological niches and habitats, different degrees of human interference, fragility, remoteness, isolation, poverty and the dependence of local residents on the flora and fauna for a livelihood.

Despite the worldwide move towards more "participatory" methods, there are still problems in finding ways to consult local people to find out which plant resources and forest areas they themselves would like to conserve. This book attempts to seek for answers to these problems using montane cloud forests. Most studies dealing with ethnobotany in the tropics stress the importance of the rain forest flora for the subsistence and survival of local populations and their cultures. Similar data are available for highlands in subtropical regions such as the Himalayas. But until now, hardly any ethnobotanical studies of tropical highlands and mountains have been conducted, and there is an almost complete lack of information on montane forests and knowledge about how their populations use these rich plant resources.



Photo: In Cameroon women are the main users of the land and their contribution to natural resource management can be a key factor to the success of conservation projects. Recording of women's perceptions of biodiversity in the Mount Cameroon Forest at Bakingili (Photo by Anna Lawrence).

This book is an effort to begin filling this knowledge gap. It presents an inventory of useful plants in the West Cameroon Highlands. The study identifies the useful indigenous plant species that are known to representatives of rural communities of residents. These communities are presently undergoing an abrupt change from traditional subsistence agriculture towards a modern economy based on fruticulture, cash crop cultivation for export and ecotourism. Conceptual issues on ecological planning for biodiversity conservation integrating local values are invoked as challenges for research. There is an urgent need to develop socio economic and ecological indices for the evaluation of biodiversity by stakeholders in complex mountain environments. If conservationists can find ways to communicate local perceptions and indigenous values of biodiversity and combine resource users' evaluations with scientific evaluations, it is hoped that local communities will have a stronger voice in the negotiation of natural resource management plans and conservation interventions. Data on indigenous knowledge and value of biodiversity combined with scientific knowledge should also provide scientists, land resource managers and the communities themselves with a clear understanding of decision-making procedures concerning their local resources and livelihoods.

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Chapter 2

Ethnobotanic Resources of Kilum - Ejim Mountain Forest

Summary

It is now being realized by development agencies that using state power to enforce protection status for forests has failed to come to grips with crucial social issues and has provoked conflicts which often undermine the possibility of implementing and achieving basic conservation objectives. This approach ignores the livelihoods of forest adjacent communities. The search for new wildlife management models has yielded the community forest management concept. The chapter appraises the implementation of this concept. It identifies the forest-dependent livelihoods and their impacts on the sustainability of the resource by using an ethnobotanical survey and a forest damage assessment rating. Group interviews of forest management institutions identified the constraints of the model from the perspective of traditional communities. The study concludes that community forest management is yet to resolve the problem of forest resource depletion due to socio-economic and political constraints and the lack of local institutional capacities to enforce management regulations and plans. Finally, it identifies the scope for supporting and strengthening existing structures and institutions and creating new ones as a basis for enforcing management plans and regulations.

Key Words: Sustainable management, forest-dependent livelihoods community forest management model, implementation constraints, strategies and control systems.

Introduction

Mountain areas are examples of less recognized regions with critical types of biodiversity (Roy, 2001). Mountain dwellers typically live on the economic margins as nomads, part-time hunters and foragers, small farmers and herders, blacksmiths, craftsmen and loggers. Given the imperative to survive, these people have acquired unique knowledge and skills by adapting to the specific constraints and advantages of their fragile, inhospitable environments. They possess millennia of experience in shifting cultivation, terraced fields, and medicinal use of native plants, migratory grazing, and sustainable harvesting of food, fodder, and fuel from forests (Pratap, 2001). With increasing demographic pressure, the failure of the state to protect

wildlife (Macleod, 1986; Denniston, 1995), the failure of protected areas to complement their surroundings and recognized the world they fit into (Stem et al, 2003 Daniel et al, 2005; Kruger, 2005), and access to markets there are emerging threats due to unsustainable forest resource use. Can rural peoples derive livelihoods from forests while protecting them? According to Tucker (2000) this question challenges communities for which forests represent a primary resource.

This chapter seeks to identify the forest dependent livelihoods, to assess their impacts on the forest and to appraise the implementation of the community forest management concept in order to identify the scope for designing sustainable strategies and control systems from the perspective of traditional forest management.

The grid reference of the summit of the mountain is 6°12'N, 10°23'E and Lake Oku 6°12'N, 10°27'E. The northern portion of the mountain is called the Kilum Mountain by Oku villages while the southern portion is called the Ijim or Ejim Mountain by Kom villages. Geographers refer to the mountain as Mount Oku. The forest is found mainly between 2022 and 3011 (summit of the mountain) above sea level. Hawkins and Brunt (1965) describe the climate of the summit as “cool, very cloudy and misty” with maximum temperatures of 16.5°C to 19°C and minimum temperatures of 9°C to 10°C. The rainfall is in excess of 3350mm/ year. The sub-montane area has been described as “cool and misty” with mean maximum temperatures of 20°C to 22°C and mean minimum temperatures of 13°C to 14°C. This rainfall varies from 1780 mm to 2290 mm per year. Most rainfall occurs between July and September. A dry season occurs from mid-October to mid – March (Hollier, 1981).

Geographically the study area is part of the Cameroonian Highlands ecoregion which encompasses the mountains and highland areas of the border region between Nigeria and Cameroon (Stuart, 1986; Gartland, 1989 and Stattersfield *et al*, 1998). Mount Oku is at an altitude of 3011m above sea level. Most of the area around the mountain is below 2600 m in elevation. The lower boundary of the forest is now determined by conversion to agricultural land. In White's (1983) phytogeographical classification, the area falls within the Afromontane archipelago-like regional centre of endemisms that spans the entire continent.

Macleod (1986) estimates that in 1963, there were approximately 17,500 hectares of forest. By 1986 less than half remained. 33% of the forest was highly degraded (Figure 1). Actual and potential threats causing forest degradation include demographic pressure (72 inhabitants / km²), grazing, fire damage, a deepening economic crisis at the national level due to the fall

in the price of coffee (the main export crop) on the world market and the lack of alternative employment. (Macleod, 1986, Ngwah, 2001).

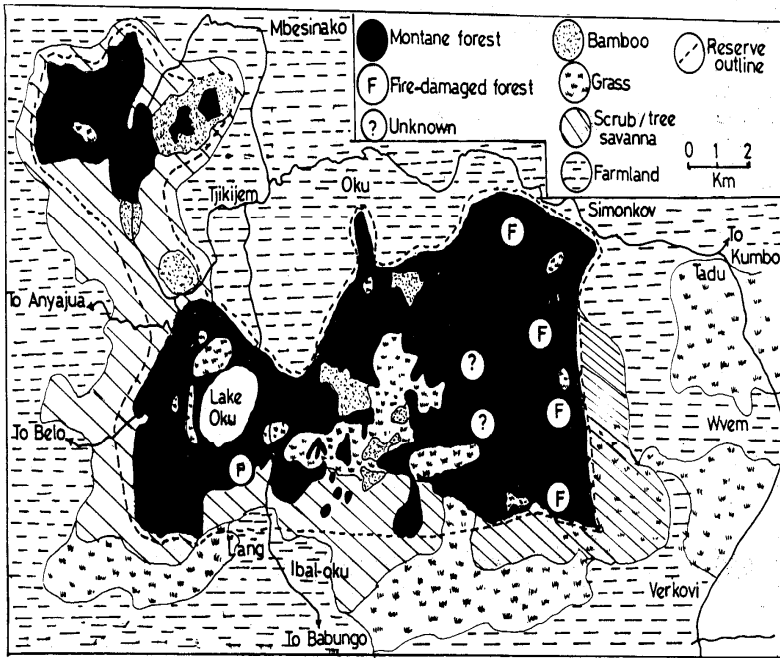


Figure 1: Vegetation derivatives of Kilum-Ijim Mountain Forest: anthropogenic degradation (Situation in 1986 after Macleod).

Jai (2007) and Mbenmbem (2007) also observed that the extraction of timber and non-timber forest products is a major threat due to bad harvesting techniques (unsustainable harvesting of forest products). Between 1983 and 1986 the annual deforestation rate was 567 hectares per year (Macleod, 1986). The retreat of the forest during this period is presented in figure 2.

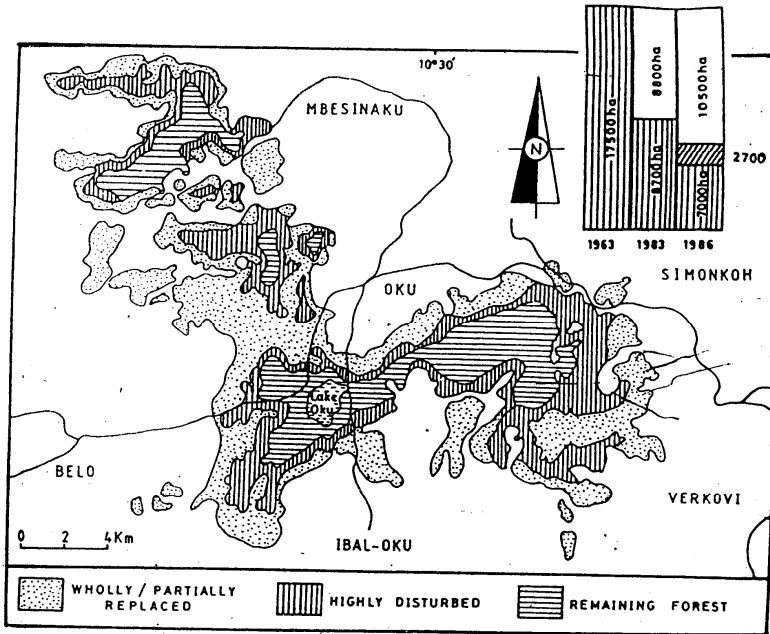


Figure 2: Retreat of Kilum – Ejim forest: Situation at the initiation of the community forestry project in 1986 (Source: Macleod, 1986)

The forests are of great ecological significance. They contain a disjunct vegetation association found nowhere else in West Africa, and several endangered species of plants and animals, including two bird species which are totally dependent on these forests for their survival (Alpert 1993; Garthland 1989; Stuart 1986 and Macleod 1986). The forest provides local employment and livelihood (Ngwah, 2001). Efforts have been made by the national government since the 1930s to protect the forest but these have so far been unsuccessful. Of the forest which occupied the area 50 years ago, less than half remains and at least 33% is highly degraded (Macleod 1986).

Macleod (1986) notes that there have been efforts to declare Oku Mountain forest a reserve since the 1930s. In 1931 it was approved as a forest reserve by the government. In 1985 the reserve status was enforced (Bawden and Langdale –Brown, 1961; Hawkins and Brunt 1965). Partial demarcation of the forest boundary began in 1975 to delimit a zone beyond which farming should not exceed and discourage forest destruction. The demarcation process was never completed and was not adequate. Demarcation pillars were small in size, were disregarded by forest-adjacent villages and so were easily moved. In July 1982, there was a retracing of the 1975 demarcation to find out the extent of encroachment by farming and grazing and the illegal exploitation of forest resources (Figure 1 and 2). In

many areas, there had been extensive encroachment and pillars had been uprooted and moved. The area was gazetted a protection forest under the forestry regulation of Cameroon (Law No. 81-13 of 27/11/1981). Within a protection forest, livelihood activities were still allowed to continue provided that they were not in conflict with the conservation of the area and were strictly controlled.

More than 80% of the 300.000 inhabitants derive livelihoods from forest-related activities. Since the 1930s there has been a wide gulf between rhetoric and policy objectives, on the one hand and the reality of policy and project implementation on the other. Numerous environmental laws and regulations remain unenforced, programmes and projects poorly implemented, while measures coined to protect or rehabilitate ecosystems often impinge negatively on livelihoods at the village or local level. (Ndenecho, 2005). In most protected sites technocratic formulae have often been imposed which generally ignore the socio-economic and cultural situation of thousands of families whose livelihoods depend on the forest. This approach has provoked social conflicts which often undermine the possibility of implementing and achieving basic conservation objectives (Gengiz, 2007; Ndenecho, 2007a; Ndenecho, 2007b, Tucker, 2000) Coupled with limited human and financial resources necessary for the administration of protected areas, most reserve status often exist only on paper (Denniston, 1995). The community forest management concept which involves participatory management with local people was adopted in 1995 (Asanga, 1995). Following the promulgation of law No. 94/01 of 20th January 1994, and its decree of application of the 23rd August 1995 the community forestry concept was adopted in the protection of the forest. The local communities co-manage the natural resource base in partnership with the government

Data Sources and Methods

In order to identify the livelihoods dependent on the forest data was obtained using ethnobotanical surveys (Ndenecho, 2006 a; Ndenecho, 2006 b; Duncan, 1989; Thomas, 1986). The survey summarized the useful plant species using their scientific names, local names, plant organs used and the local uses. Based on the work of Ndenecho (2006 b) the useful plants were subsequently classified according to life form, that is, emergent trees, small trees, shrubs, climbers, herbs, epiphytes, succulents, bulbs, corms and tubers. The impact of livelihood activities on the forest was made using a forest damage assessment rating by the Lang Forest user Group (Ngwah, 2001). Sixteen forest user groups under six forest management institutions were identified and mapped (Jai, 2007). The study then conducted a single

interview for each community forest management institution using the group leaders. Information was collected in six single interviews on their assessment of the impact of livelihood activities on the forest, the institutionalization of a community forest management strategy and the major constraints involved in its management. The basic hypothesis underlying the group interview is that the group leaders have an excellent “feel” for the community problems and conditions unlike a survey where the respondent is asked to generalize about himself and his livelihoods. In this study the group leaders were asked to generalize about the community and the functioning of user groups.

Results and Discussions

Table 1: Forest user groups (FUG) and institutions in Kilum-Ejim Mountain Forest (Figure 3).

Forest User Groups (FUGs)	Length of Forest Boundary (m)	Forest Management Institution (MFI)
Ngashie	3.332	Emfveh mii
Keyon	1.505	
Manchok	3.296	
Ngvuinkei II	1.295	
Mbockevu	8.466	Upper Shinga
Lang	5.466	
Ngemsiba	1.486	
Ngvuinkei I	4.113	
Mbockenghas	3.860	Nchiyy
Simonkoh	3.139	Mbai
Ichim	3.139	Ijim
Jikijem	2.711	
Mbockejikijem	3.618	
Mboh	2.412	Kejem-mawes
Kesoten	2.982	
Jiyane	3.615	

Source: Jai, 2007

Table 1 and figure 3 present the forest-adjacent villages and the forest management institutions (FMI). A forest management institution is

composed of forest user groups (FUG). The area has six FMI and sixteen FUG. The forest management institutions are grouped under an umbrella organisation known as the Association of Forest management Institutions (AFMI). The forest management institutions work with village traditional institutions (Chief, notables, indigenous religious institutions) and related government agencies to design a management plan for the forest. Technical and financial support is rendered by the government of Cameroon through a Technical Operation Unit (TOU) of the Ministry of Forest and the Environment. Between 1986 and 1989 Birdlife International supported the Kilum and Ejim Mountain Forest Projects in the conservation of biodiversity and the promotion of sustainable livelihoods. After 1989 the project facilitated the formation of forest user groups and management institutions. International support ended in 1995 and it was expected that the government will continue to give technical and financial assistance to the villages managing their forest through the Technical Operation Unit.

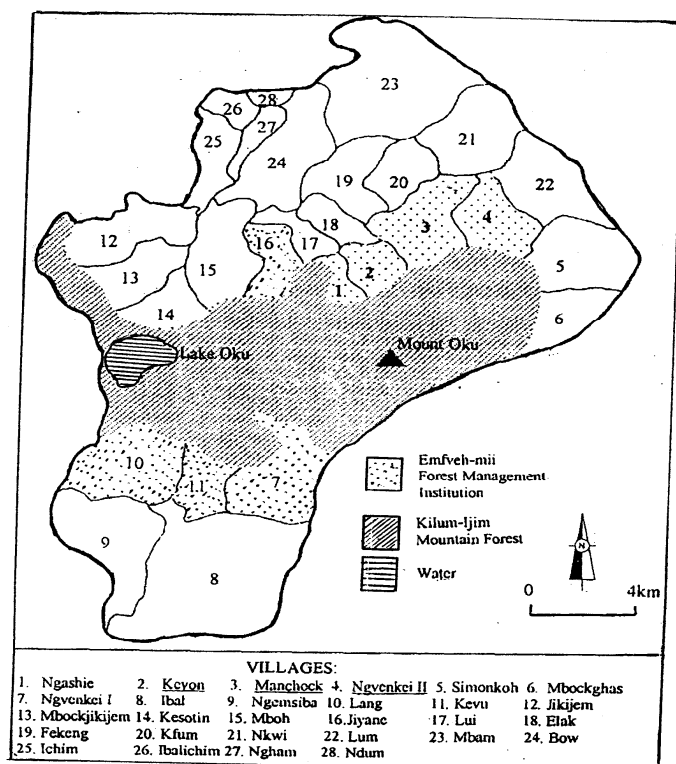


Figure 3: Kilum – Ejim forest –adjacent villages and community forest management institutions (Ndenecho, 2006 a).

The main components of the community forest management plan are decided upon by the user groups in group meetings. These include the objectives and the management rules. The rules guide both the primary and secondary users. The primary users are villagers whose main livelihoods depend on forest products (timber and non-timber forest products). Forest management decisions are made by the primary users. Secondary users are villagers who do not directly depend on the forest. They have grazing and farming rights in designated sites at the forest periphery. Tertiary users are villagers who do not directly use the forest as a source of livelihood. Management plans generally include routine fire-tracing of the forest periphery, routine policing by group members to enforce voluntarily agreed upon rules and regulations, rehabilitation of critically degraded sites and the development and enforcement of land use plans to accommodate the main livelihoods provided by the forest (Table 2).

Table 2: Distribution of plants of Kilum –Ejim forest according to life form, habitat and indigenous uses.

Species	Local name	Form	Habitat	Uses
<i>Minulopsis solinsii</i>		HB, SB	FO	FW
AGAVACEAE				
<i>Sansevieria trifasciata</i>	<i>Elang</i>	HB,CT	CT	FW
<i>Dracaena deisteliana</i>	<i>Nkeng</i>	SB	CT	TR
ALANGIACEAE				
<i>Alaungium Chinese</i>	<i>Febom</i>	TL	FO;SC	IN
ANACARDIACEAE				
<i>Sorindeia peleoides</i>	<i>Kentieh'she</i>	TS, SB	SC,CT	TR;TC
ARALIACEAE				
<i>Polyscias fulva</i>	<i>Keghang</i> <i>Kebongsa</i>	TS;TL	FO;CT	TC;OT
<i>Schefflera abyssinica</i>	<i>Djia</i>	TL	FO	TC;HO
<i>Schefflera barteri</i>	<i>Elang</i>	TS;EP	FO	FE;MD
<i>Schefflera mannii</i>	<i>Ebwos-revus</i>	T;	FO	TC;HO
APOCYNACEAE				
<i>Rauvolfia vomitoria</i>	<i>Ebtum</i>	TS	SC;FO	TC
<i>Tabernaemontana</i>	<i>Ebtum</i>	TS	SC;FO	TC
<i>Voacanga Africana</i>	<i>Ebtum</i>	TS	FO;CT	MD
BALSAMINACEAE				

<i>Impatiens bartonia</i>	<i>Kimvas</i>	HB	SC	FO
BASELLACEAE				
<i>Bassala alba</i>	<i>Kefu feyin</i>	LN	SC;FM	MD
BIGNONIA				
<i>Kigelia Africana</i>	<i>Kinlieb'she</i>	TS	SC;CT	TR;TC
<i>Markhamia tomentosa</i>	<i>Enggweh</i>	TS	SC;CT	MD
BARAGINACEAE				
<i>Cynoglossum</i>	<i>Imbanen</i>	HB	SF;FO	MD
<i>Coreopsis barteri</i>	<i>Foll</i>	HB	FM;SC	
COMPOSITAE				HO
<i>Crassocephalum manni</i>	<i>Ngangang</i>	TS	SC	
<i>Emelia coccinea</i>	<i>Ebjenen</i>	HB	SC	AG
<i>Vernonia leucocalyx</i>	<i>Keghanghang</i>	SB;TS	SC	MD
<i>Vernomia sp.</i>	<i>Keghanghang</i>	SB	SC	
CRASSULACEAE				D
<i>Bryophyllum pinnatum</i>	<i>King-ketuleh</i>	HB	SC	MD
<i>Kolancchoe laciniata</i>	<i>Ketubleh</i>	HB	SC	
<i>Kolancchoe laciniata</i>	<i>Ketubleh</i>	HB	SC;FO	MD
CUCURBITACEAE				MD
<i>Momordica foetida</i>	<i>Ebifierfer Nak</i>	LH	SC	MD
ERICACEAE				
<i>Aguaria salicifolia</i>	<i>Bhang</i>	TS	FO;SC	MD
EUPHORBLACEAE				
<i>Bridelia speciosa</i>	<i>Eblum</i>	TS	SC	FE
<i>Croton marcrostacyus</i>	<i>Ebjam</i>	TS;TL	FO;SC	TC
<i>Euphorbia kamerunica</i>		HB	CT	MD
<i>Neoboutonia velutina</i>	<i>Fa'ngum</i>	TS	FO;SC	MU
<i>Ricinus communis</i>	<i>Jang</i>	TS;SB	CT	MD
<i>Sapium ellipticum</i>	<i>Kehtorb</i>	TL	FO;SC	MD
FABACEAE				
<i>Phaseolus vulgaris</i>	<i>Ekuum</i>	HB	CT	MD
GRAMINAE				
<i>Arundinaria alpina</i>	<i>Ebtotom</i>	SB	FO	CF
<i>Melinis minutiflora</i>	<i>Fejang-e-egwei</i>	HB	GR	MD
<i>Oxytenanthrea abyssinica</i>	<i>Mbangsehtotom</i>	SB	GRLCT	CF
<i>Zea imperata sp.</i>		HB	FM	MD
<i>Leptanlus daphnoides</i>	<i>Salangang</i>	TS	FO;GL	DY
LABTATAE				

<i>Plechinthus esculenths</i>	<i>Ndongfenkeir</i>	SB	GR;CT;FM	FO
<i>Satureja robusta</i>	<i>Fegis</i>	HB	SC	MD
LEEACEAE				
<i>Leea guineensis</i>	<i>Cheng</i>	SB	FIMSC	MD
LILIACEAE				
<i>Albua nigritata</i>	<i>Kelend fejin</i>	SB	GR	MD
MALVACEAE				
<i>Sida rhombifolia</i>	<i>Nshim</i>	SB	SC	FB
MARATTIACEAE				
<i>Marattia frazinea</i>	<i>Kelang</i>	SB	AQ;FO	MD
MALTACEAE				
<i>Carapa grandiflora</i>	<i>Evum</i>	TL	FO	FW
MOSACEAE				
<i>Albizia gummifera</i>	<i>Fuim</i>	TL	FO	TB
<i>Newtonia buchananii</i>	<i>Kilarni</i>	TL	FO	TB
MONIMLACEAE				
<i>Xymalos monospora</i>	<i>Fegei</i>	TS	FO	CF
MORACEAE				
<i>Ficus exasperate</i>	<i>Keghawus</i>	SB	FO	MD
<i>F. oreodryadum</i>	<i>K'ghumfigak</i>	TL	FO	TR;FE
<i>Ficus sp.</i>	<i>Ntob</i>	TL	FO	FF
MYRSINACEAE	<i>Kenlimlim</i>	LW	FO	FE;MD
<i>Maesa lanceolata</i>	<i>Seim</i>	TS	FO;SC	MD
<i>Rapanea melanoeneura</i>	<i>Ntobkob</i>	TL	FO	CF
MYRTACEAE				
<i>Syzygium staudtii</i>	<i>Oweb</i>	TL	FO	HO;FN
PALMAE				
<i>Raphia farinifera</i>	<i>Eluk</i>	TS	CT	CF;AL
PAPILLIONACEAE				
<i>Crotalaria</i>	-	SB	SC;FM	AG
<i>Millettia conraui</i>	<i>Efeumen</i>	TS	SB	OT
<i>Sesbania sesban</i>	<i>Eyis</i>	SB	CT;FM	AG
<i>Tephrosia preussii</i>	-	SB	SC;GR	AG
<i>Tephrosia vogelii</i>	<i>Koblen</i>	SB	CT;FO	AG,MD
PHYTOLACCACEAE				
<i>Phytolacca aodecandra</i>	<i>Etohtam</i>	SB	FO	TR
PIPERACEAE				

<i>Piper capense</i>	<i>Boboi</i>	EPIHB	FO	MD
<i>Piperomia fernadoensis</i>	<i>Mboi</i>	TS	FO	MD
RHIZOPHORACEAE				
<i>Cossipourea ugandensis</i>	<i>Elung</i>	TL	FO	TB
ROSACEAE				
<i>Prunus africanus</i>	<i>Eblab</i>	TL	FO	MD;TB
<i>Rubus pinata</i>	<i>Bakob</i>	TF	SC	FO
RUBACEAE				
<i>Canthium dunlapii</i>	<i>Bangefonembessei</i>	TS	FO	TR
<i>Corynanthe pachyuras</i>	<i>Owing</i>	TL	FO	FW
<i>Curiera longifolia</i>	<i>Ketyelum</i>	TS	FO	FO
RUTACEAE				
<i>Clausena aniseta</i>	<i>Fii</i>	TS	FO	IN;MD
<i>Fagara rubescens</i>	<i>Bjung</i>	TS	FO	MU
SAPINDACEA				
<i>Allophyllus bullatus</i>	<i>Njiabas</i>	TS	FO	CF
SOLANACEAE				
<i>Datura candida</i>	<i>Eytobkin</i>	SB	CT	FE

KEY:

* Life form * Uses (Livelihoods)

TL = large tree = emergent trees

TS=SMALL TREE

LN = climber

SB = shrub

HB = HERB

EP = epiphyte

BB =bulb/tuber/corm

SU = succulent

OT = others

Habitat

IN = insecticide

FO= Forest

GR = grassland

CT = cultivated fields

AQ = aquatic

AG= agroforestry

FO = food

TB = timber

AL = alcohol

FW = firewood

TC = wood carving

CF = construction fibre

HO = honey

DY= dye

MU = musical instruments

FE= fence

MD = medical

SC = scrub
FM = farmland

TR=ritual rites/traditional uses.

Table 2 presents the useful plants of Mount Oku and the livelihoods they support (Ndenecho, 2006 a, Ndenecho, 2006 b; Duncan, 1989). It presents the particular use of plant species and the plant organs used. These plants are native to the area. A total of 86 plant species support various livelihood purposes (Ndenecho, 2006a).

Table 3: Distribution of the useful plants species according to life-form (Ndenecho, 2006 a).

<i>Number of useful plant species per life form</i>								
<i>Users</i>	<i>Large trees</i>	<i>Small trees</i>	<i>Shrubs</i>	<i>Climbers</i>	<i>Epiphytes</i>	<i>Herbs</i>	<i>Bulbs, tubers & corms</i>	<i>Succulents</i>
Timber	5	0	0	0	0	0	0	0
Alcohol	0	1	0	0	0	0	0	0
Firewood	3	0	1	0	0	0	0	0
Wood	4	0	1	0	0	0	0	0
carving	0	5	1	0	0	0	0	0
Construction fibre	3	2	1	0	0	0	0	0
Honey(apiculture)	1	0	0	0	0	0	0	0
Insecticide	0	1	0	0	0	0	0	0
Dye	2	2	4	3	2	1	4	5
Musical instrument	2	1	4	0	0	1	0	0
Fencing poles	0	9	1	0	0	0	0	0
Medicinal	0	2				1		
Agroforestry		1						
Food								

Large trees = emergent trees.

Tale 3 analysis the plant life according to life form and uses. The main use categories were timber, alcohol, fuelwood, wood carving, construction wood, fibre, honey, dye, musical instruments, fencing poles, medicinal (remedies, flavourings), insecticides, construction material and agroforestry. Emergent trees, small trees and shrubs offer the highest number of uses. Herbs, bulbs, corms and succulents are mainly used for medicinal purposes. Herbs constitute 27.5%, small trees 22.5%, shrubs 10%, bulbs/corms/tubers 10%, climbers 2%, emergent trees 5 and epiphytes 5% of total medicinal plants. The total number of useful plants is distributed as follows: Medicinal plants 40 species, woodcarving 10 species, agroforestry 6 species, timber 5 species and fire wood 4 species. The rest of the plants offer only minor uses.

Table 4: Damage assessment rating by the Lang Forest User Group

Livelihood	High Damage	Some Damage	No Damage
Hunting		*	
Grazing		*	
Honey (wild)		*	
Honey (hive)		*	*
Carving		*	
Firewood		*	
Trapping		*	
Tool handles	*		
Medicine		*	
Rope			*
Edible fungi			*
Adhesive gum			*
Wild vegetables			*
Traditional red feather			*
Oil containers			*
Agricultural encroachment	*		
Accidental bush fires	*		

Source: Ngwah, 2001

Table 4 presents a forest damage assessment rating per livelihood activity as perceived by the Lang Forest User Group. This is the largest group (Ngwah, 2001). Forest user identified agricultural encroachment, handicraft and accidental bush-fires as major threats to the forest. Hunting, grazing at

the forest periphery and invasion of the forest by cattle and goats, wild honey collection resulting in accidental bush-fires, fuelwood collection and the harvesting of medicinal plant organs were judged to be causing some damage to the forest. These according to forest users threaten the sustainability of all livelihoods. From group discussions and informal interviews of forest users, the following constraints in the implementation of the community forest management concept were identified:

- Community environmental knowledge may have accumulated over many generations, but since it is gained from experience it encompasses only those aspects of the local environment which are important to people's livelihoods. Local people tend to have much more comprehensive knowledge of the many uses to which local trees and shrubs may be put, than how actively to grow them.
- Rural livelihoods systems are dynamic. They are open to changes brought about by the primary, secondary and tertiary forest users. Each group applies knowledge in different ways to solve land management problems as they arise. They therefore, show interest in the management of the forest differently. For example, in the event of fighting a devastating forest fire bee keepers react fast because fires will destroy their hives and colonies. Fuel wood gatherers, herbalists, farmers and graziers are apathetic because it does not affect them directly and immediately. This often generates land use conflicts among user groups as the fire will favour some livelihood activities (grazing, farming, fuelwood collection, new growth of herbs and fibres) and will adversely affect other livelihoods (bee keeping, hunting, wood carving).
- The effective adoption and implementation of community forestry is adversely being affected by the process of commodification, that is, the ongoing economic crisis, the lack of alternative livelihood activities and the demand for forest products. This often leads to a sacrifice of the common good for short term individual gain.
- Population pressure on the forest and incipient forest resource depletion in many villages are exceeding the capacity of local institutions to adapt and manage environmental change.
- Interventions of the Technical Operations Unit in community forest management such as the provision of external inputs (material, financial, technical) for the promotion and realization of local potentials have been wanting.
- The process of the participatory mapping and institutionalization of community forests has also been hindered by disputes over land tenure

between villages. To resolve these disputes the boundary between the Ejim villages and Kilum villages was demarcated by a plant life sanctuary which today is poorly managed. The process of forest boundary negotiation between villages needs to be facilitated.

- Most importantly, local institutional capacities have been eroded and overwhelmed by the pace of change. The commodification of forest products (penetration of the cash economy) through the Honey Production and Marketing Cooperative, Handicraft Marketing Cooperative and Farmers Cooperatives, fuel wood demands by village bakeries and urban centres, and the commercial and industrial exploitation of *Pygeum africanus* bark have caused the poor and powerless to local access to productive resources as powerful local interest groups, individuals and outsiders consolidate their control over them. This has led to resource “mining” of forests and natural pastures. The forest management institutions are therefore fragile due to the weakening of community controls and stability.

The forest management institutions charged with the conservation of their local forests deriving livelihoods from them and exhorted to plant trees in critically degraded sites are failing to achieve these objectives. The community management scheme lacks both the real backing of the primary, secondary and tertiary users (local people) and the institutional means to make enforcement effective. Due to this failure land degradation is continuing (Jai, 2007; Mbenmbem, 2007; Icick, 2007; Bekolo, 2001). Arnold and Campbell (1985) recommended that community sanctions are the ideal mechanism for the enforcement of rights through voluntary agreements of rights in fairly small and clearly defined village groups. They argue that this approach is more likely to put local people’s priorities first, to be effective and to be sustainable in economic and social terms. Table 5 summarizes the many types of possible control systems which can be used in traditional management by villages.

Table 5: Distribution of control systems in traditional forest management by illustration of uses.

Basis of group rules		Examples
	Harvesting only selected components	• Trees: timber, fuelwood, fruit, nuts, seeds, honey, leaf fodder, fibre, life mulch, other minor products (gums, resins, dyes, liquor, plated leaves, etc) • Grass: fodder, thatching, rope, • Other wild plants: medicinal herbs, food,

		bamboos, etc. • Other cultivated plants: maize, millet, wheat, potatoes, beans, vegetables, fruits, etc. • Wildlife: animals, birds, bees, other insects, etc.
	Harvesting according to condition of products	• Stage of growth: maturity, alive or dead • Size, shape • Plant density, spacing • Season (flowering, leaves fallen, etc) • Part: branch, stem, shoot, flower.
	Limiting amount of product	• By time: season, days, year, several years • By quantity: of trees, head loads, baskets, animals • By tools: sickles, saws, axes, hoes, cutlasses • By area: Zoning, block, types of terrain, altitude • By agency: women, hired labour, children, contractor, type of animal.
	Using social means for protecting areas	• By watcher: paid in grains or cash • By rotational guard duty • By voluntary group action • By making mandatory the use of herders to watch animals

Source: Modified after Arnold and Campbell (1985)

The critical issue is not so much what rules are applied but the strength of community institutions which set the rules and ensure that they remain effective. Community sanctions are most likely to arise spontaneously and work where a cohesive social and administrative structure exists. This will tend to be in relatively isolated villages which are little affected by commodification and rapidly changing socio-economic framework conditions. There is a need to search for ways of strengthening the basis for the enforcement of management regulations in the villages. It may be possible to support and strengthen existing structures and institutions, or create new ones where the basis of rule making is totally lacking.

Conclusion and Recommendations

The “conservationist” approach to biodiversity conservation has failed to come to grips with crucial social issues – it ignores the socio-economic and cultural situation of rural people whose livelihoods depend on the forest. It provokes conflicts which often undermine the possibility of implementing and achieving basic conservation objectives. There is need to search for new forest management models. The community management model can enhance the sustainable development of forest-adjacent communities if the following crucial aspects are considered.

- Access right must be transferred to fairly small and clearly defined user groups through voluntary agreement of use rights.
- Forest exploitation and communities empowered to undertake sustainable harvesting of products.
- Local institutions must be supported and strengthened as a base for the enforcement control systems, rule making, provision of environmental education, supervision, organisation and use of resources and to ensure a fair distribution of income.
- The establishment of a control and functioning mechanism as a prerequisite for achieving ecological stability
- The setting up of large conservancies at village level with user groups that will monitor access, set quotas and control access.
- Promotion of conservation initiatives at the level of forest user groups based on sustainable management and self-financing. Current financing through international aid and state funding has failed.

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Herbalism and Resources for the Development of Ethnopharmacology in Bamenda Highlands

Summary

Most traditional African Cultures believe that, to maintain the health and vitality of human beings, they have to address forces in both the natural and the spiritual world. The paper uses a participatory approach to identify the strengths, weaknesses, opportunities and threats of the traditional health system. It presents some concepts and practices, some characteristics of indigenous knowledge transfer system and some aspects of their link with Western health care based on a participatory assessment, primary and secondary data sources. The chapter concludes that the traditional health system is very complex. Failure to understand and appreciate these complexities has led to a great number of failures in the cooperation between African traditional medicine and the Western health care system. It therefore identifies the scope to enhance the strengths and challenge the weakness of the traditional practices. It recommends that there is a need to research for methods of testing, refining and validating indigenous knowledge in traditional medicine in order to support the process of integration in the Western health care system.

Key Words: Traditional health care system, indigenous knowledge, medicinal plants, participatory assessment, ethnopharmacology, Cameroon.

Introduction

Before the advent of Western Science, medicinal practice as applied to human being was probably very similar in all parts of the world (F.A.O., 1984). The healing art consisted of two major elements that were often used in combination: the application of natural products and an appeal to spiritual forces. Natural products include extracts or decoctions from leaves, roots, oils, fats, animal parts or insects. Appeals to spiritual forces involved incantations, symbols and sacrifices among other rituals (Darshan and Bertus, 2000; Juan *et al*, 2000). These practices are still very common in many cultures. The World Health Organisation (WHO) estimates that 70 to 80% of the people in developing countries use traditional medicine as a major source of health care. Many African cultures have a holistic perception of health and vitality. Vitality is the energy to sustain life. It is the essence of

health (Darshan and Bertus, 2000). In this perception five entities are considered: God, the superhuman and ancestral spirits; mankind; biological life forms (plants and animals); and finally all phenomena and objects that do not have a biological life. De Smet (2000) and Mbiti (1969) describe how these entities are always included in traditional African health care. In addition to these five entities there is a “vital life force” that permeates the whole universe (Esdt sieck, 1977); Haverkort et al, 1999; Haverkost, 1999).

For the African every person, plant, animal and natural phenomenon is a carrier of the divine. God is the source and ultimate controller of the vital forces, while the spirits have access to some of these forces. A few human beings have the knowledge and ability to tap, manipulate and use the vital forces, such as medicine men, witches, priests and rainmakers. The vital life forces can be benevolent or malevolent, and used in both positive or negative ways (Bossard, 1996). The role of witches and to a lesser extent, diviners, is to address the “negative” powers. They can cause or cure a curse given to a person, an animal or a location. The priests and traditional healers normally use positive spiritual powers. In order to appease the gods, people have to perform rituals and make sacrifices. The traditional cultures accept that the vitality of human beings, animals, plants and environments are interrelated. Moreover, only when different needs at the physical, mental and spiritual level are balanced, is well being and vitality possible. Ironically, traditional medicine is today being challenged by Western biomedical tradition. This chapter presents some concepts with respect to human health from an indigenous perspective, the potentials, the threats and possibilities for a way ahead in the development of ethnopharmacology.

The Oku village communities are located in the Bamenda Highlands of Cameroon. The area is characterized by several micro-Kingdoms located in mountainous landscapes. The highest peak is Mount Oku (3011m above sea level). The grid reference of the summit of Mount Oku is 6°12'N and 10°32'E (Figure 1). Land under natural forest including degraded forest is 6900 hectares, area under tree and shrub Savanna 2400 hectares, grass Savanna 1240 hectares and montane forest 17,325 hectares (Macleod, 1986). A population of 300.000 people depends on the forest for livelihoods. The area possesses some of the most intact cultures of the region. As a result of neglect and marginalization, the area, its biodiversity, and the people and their culture are vulnerable

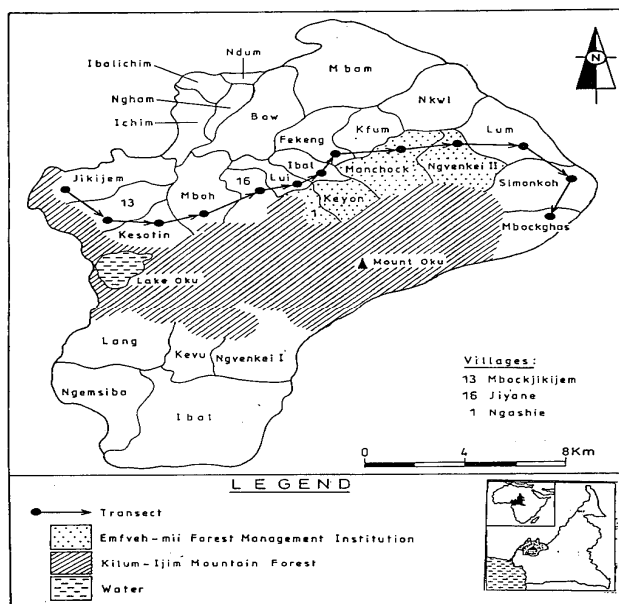


Figure 1: Location of the Study area and villages investigated in Oku, Cameroon to environmental, socio-economic and political change. Biologically, the high level of endemism among vascular plants and some fauna leaves them vulnerable to species loss. Culturally, the fact that the local people are ethnic minorities, outside of the dominant cultures of the lowland areas, leaves them distant the centres of commercial and political power where most of their fate is determined. This enormous diversity makes the area one of the last major opportunities for conserving natural and human variety and the development of ethnopharmacology.

Villages around Mount Oku have long been known as centres of traditional healing. People travel over 400km to receive treatment. Although traditional medicine in the area has been the focus of several recent studies (Krafczyk, 1982 cited by Macleod, 1986), little is known about the plants that are used in the preparation of medicines. Studies have focused more on the ethnobotanical survey of the area (Ndenecho, 2007; Ndenecho 2006; Tame, 1993 and Thomas, 1987). Further work is necessary on Scientific identification and inventory of medicinal plant species. These are threatened by anthropogenic degradation.

Disease Perception and Research Methodology

According to Morris (1996) and Bossard (1996), Africans distinguish between four causes of disease. First, the natural cause of disease, equated with acts of God. Second, there are diseases related to moral or ritual infringement, like sexual abuse, stealing, killing or ignoring taboos. The third kind of disease is associated with witchcraft or sorcery. Finally, there are diseases associated with spirits, like the ancestral spirits. In order to understand and appreciate these complexities a participatory assessment of the characteristics of the traditional health systems was made through dialogue with local people. Based on ethnobotanical surveys for the area, medicinal plant potentials were established (Ndenecho, 2007; Ndenecho, 2006; Tame, 1993; and Thomas, 1987) and their role in the traditional health system, threats and opportunities identified. Using a combination of primary and secondary data sources the scope for testing and refining practices to support the process of endogenous development was identified and the feasible links with Western medicine established, that is, identify the scope for cooperation between the rural people and outsiders. The SWOT (strengths weaknesses, opportunities, threats) analysis was done by determining opportunities and threats and strategic suggestions were then presented for development.

Results and Discussions

The concept of traditional medicine

The mountain dwellers believe that life forces are manifested in everything. The spirit or power is the essence of every living creature, natural event or inanimate object. These life forces all have their own personalities and cosmic place. Therefore, the preservation or restoration of health is impossible without them. Traditionally, they use herbal and animal products as medicines, intoxicants, and poisons in their struggle for survival and in their quest for religious experiences. A healer's power is not determined by the number of medicinal plants he knows but by the ability to apply an understanding of the intricate relationship between the patient and the world around him. Unlike a doctor trained in Western biomedicine, the healer looks for the cause of the patient's misfortune in the relationship between the patient and his social, natural and spiritual environment. Figure 2 presents these complex links (Bossard, 1996).

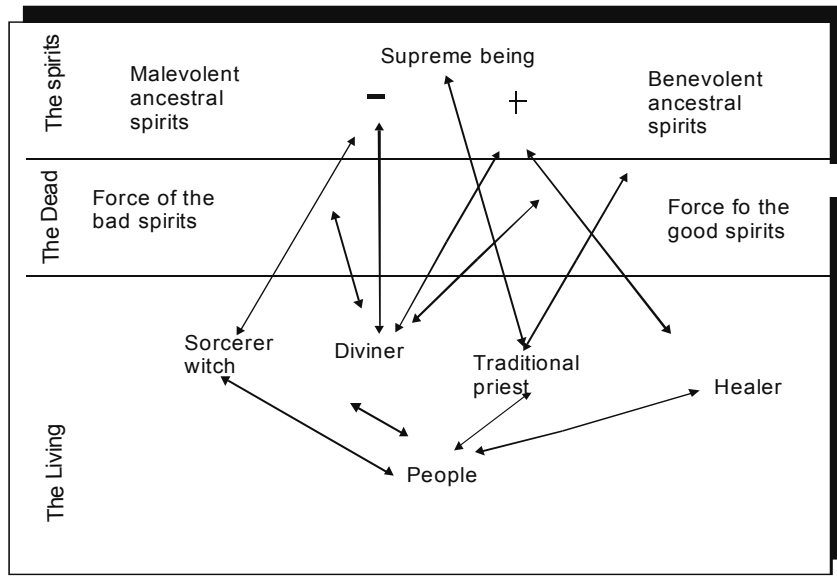


Figure 2: The link between people, spiritual healers and the spiritual world with its positive and negative forces (Bossard, 1996)

The diagnosis of disease by a traditional healer is based on an understanding of the concepts presented in figure 2, that is, it is not limited to direct observation tests. Many supernatural methods are used, such as “reading” an egg, and cola nut seeds, or cowries. Sometimes fowls are used in diagnosing disease. In the people’s culture “healing hands are a gift from the gods”. There are no schools or other formal training centres for learning traditional healing practices. Preventive and curative measures are in line with the holistic view of health and disease (Pottier, 1993). They combine the use of herbs with certain symbolic and mystical activities. Along with the medicinal treatment, a ritual is needed to re-create adequate spiritual conditions for a healthy life. Failure to understand and appreciate these complexities has led to a great number of failures in the cooperation between healers and outsiders (Darshan and Bertus, 2000).

The traditional health system

The traditional health system has the following components:

- **Diviners:** Divination and healing are often practiced by the same person, who has the power to deal with the spiritual realm. They look for

disturbing events in the past, which can cause misfortune if left untreated. Many healers are specialized in one or more biomedical aspects, such as herbalism, midwifery or surgery. There has been a tendency in western medical journals to play down such expertise by focusing on the risks of traditional medicine. Though there is a genuine cause for concern, it is unfair to pass judgment on traditional healing simply on the bases of its worst results.

- **Herbalism:** Common ailments, such as headaches or coughs are considered to be diseases with natural causes. Their symptoms are treated at the household level, without resorting to magical practices. For other illnesses, or when a common ailment persists, recourse is sought to divination in combination with herbalism. Herbal medicines are applied to every part of the body in any conceivable way. There are oral forms, enemas, fumes to be inhaled, vaginal preparations, fluids administered into the urinary tract, preparations for the skin and various lotions and drops for the eye, ear and nose. Table 1 presents a provisional list of Mount Oku medicinal plants.

The traditional healer knows the virtues of the native plants. The healing includes all elements of the natural community, that is, the human society and its environment; mountains, clouds, plants, water, animals and streams. Not everyone can cure everything. According to the lineage, this “depends on the hand of each traditional healer”. The belief is that the cure comes from something sacred deep within the healer. For this reason the genuine healers never ask to be paid for their services. Their compensation depends on the discretion of the patient.

Table 1 presents a partial list of the medicinal plants of Mount Oku. Hundred of wild plants have medicinal value but this knowledge base remains secret. Few plants are used to cure a single illness or disease. The preparation of a mixture of several plants is common. These medicinal plants cannot be gathered at any time of the day; they have their proper time. This is because the spirits of the plants can only be found in their “bodies” at certain moments. Moreover, they must never be pulled or torn violently during harvesting; first, the healer must pray to the guardians of the plant using incantations. The mountain is the place with particular strength of the medicinal plants. Mount Oku cloud forest is well known for its abundant biodiversity and rich endemism among vascular plants. The famous traditional healers in the West Cameroon highlands are mountain dwellers in Oku and Ejim areas.



Photo: Traditional healer using herbs and spiritual powers on a patient.

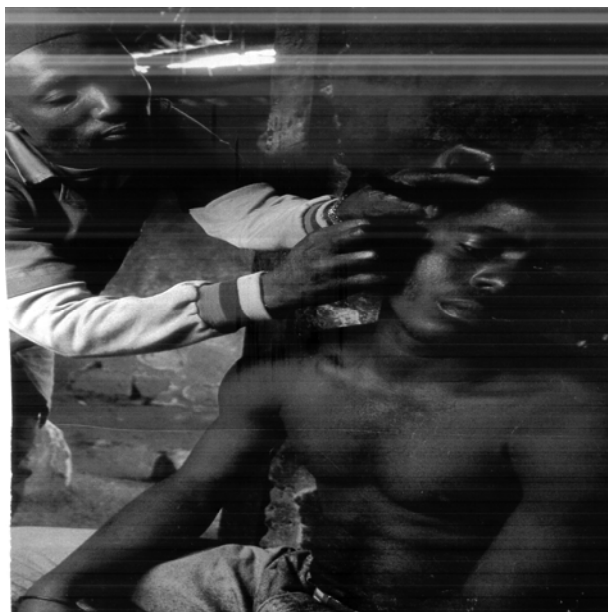


Photo: Natural pharmacy, the forest at Oku supplies herbs for a healer. The highlanders are known for their traditional medical practitioners.

Table 1: Provisional list of medicinal plants of Oku

Species	Local Name	Form	Use
<i>AGAVACEAE</i> <i>Dracaena deisteliana</i>	Nkeng	shrub	ritual
<i>ANACARDIACEAE</i> <i>Sorindeia peleoides</i>	Kintieh'she	shrub	ritual
<i>ARALIACEAE</i> <i>Schefflera barteri</i>	Elang	small tree	medicine
<i>APOCYNACEAE</i> <i>Rauvolfia vomitoria</i> <i>Voacanga africana</i>	Ebtum Ebtum	small tree small tree	medicine medicine
<i>BASELLACEAE</i> <i>Kigelia africana</i> <i>Markhamia tomentosa</i>	Kefu feyin	climber	medicine
<i>BIGNONIACEAE</i> <i>Kigelia Africana</i> <i>Markhamia tomentosa</i>	Kinlieh'she Enggweh	small tree small tree	ritual medicine
<i>BORAGINACEAE</i> <i>Cynoglossum sp.</i>	Imbanen	herb	medicine
<i>COMPOSITAE</i> <i>Grassocephalum sp.</i> <i>Lactuca grandulifera</i> <i>Lactuca schweinfurthii</i>	Nganggang Chyinawum Chyinawum	herb herb herb	medicine medicine medicine
<i>CRASSULACEAE</i> <i>Bryophyllum pinnatum</i> <i>Kallanchoe laciniata</i> <i>Kalanchoe crenata</i>	King-ketuleh Ketuleh Ketuleh	herb herb herb	medicine medicine medicine
<i>CUCURBITACEAE</i>			

<i>Momordica foetida</i>	Ebfierfer Nak	climber	medicine
ERICACEAE <i>Agauria salicifolia</i>	Bhang	small tree	medicine
EUPHORBLACEAE <i>Euphorbia Kameranica</i> <i>Ricinus communis</i> <i>Sapium ellipticum</i>	Ebjam Jang Kehtoh	herb small tree large tree	medicine medicine medicine
FABACEAE <i>Tephrosia preussi</i> <i>Phasedus vulgaris</i>	Kohlem Etuum	small tree herb	medicine medicine
GRAMINAE <i>Melinis minutiflora</i> <i>Zea imperata</i>	Tejang-egwei	herb	medicine medicine
LABIATAE <i>Satureja robusta</i>	Fegis	herb	medicine
LEEACEAE <i>Leea guinensis</i>	Cheng	shrub	medicine
LILIACEAE <i>Albuca nigrinata</i>	Kerland fejin	shrub	medicine
MARATTLACEAE <i>Marattia frazinea</i>	Kelang	shrub	medicine
MORACEAE <i>Ficus exasperata</i> <i>Ficus Oreodryadum</i>	Keghewus K'ghum figgak	shrub large tree	Medicine ritual
MYRSINACEAE <i>Ardisia cymosa</i> <i>Embelia schimperii</i>	Enchia Kenlimlim	shrub climber	medicine medicine
PALMAE <i>Raphia farinifera</i>	Eluk	small tree	ritual
PHYTOLACCACEAE <i>Phytolacca aodecandra</i>	Etohtam	shrub	ritual
PIPERACEAE <i>Piper capense</i>	Boboi	herb	medicine
PEPEROMLACEAE			

<i>Peperomia fernadoipoisna</i>	Mbol	small tree	medicine
ROSACEAE <i>Prunus africanus</i>	Eblah	large tree	medicine
RUBACEAE <i>Canthium subcordatum</i>	Bangefonembessi	small tree	ritual
RUTACEAE <i>Clansena anisata</i>	Fli	small tree	medicine

The plants presented in table 2 constitute the base for herbal medicine in the area. De Smet (2000) noted that more than 50% of the western drugs currently available are either directly or indirectly based on natural substances. In Oku herbal medicines are even more important. They are an essential component of healing. Moreover, these herbs can also play an important role in the western medicines practised in the region. Herbal medicines are readily accepted in the Bamenda Highlands as a whole, and are widely used. They are much cheaper than western synthetic pharmaceuticals. Traditional medicine stands and stores are becoming a common feature of urban landscapes in the region. These have been promoted by common initiative groups and non-governmental organizations composed of traditional healers. Unfortunately, the habitats of these medicinal plants are threatened by anthropogenic degradation. The highlands are a land pressure area (Ndenecho, 2005).

At the regional level, the Limbe Botanic Garden recently embarked on the collection of medicinal and economic plant species for *ex-situ* conservation. A list of these plant species is presented in the appendix (See the appendix). All information recorded (Use, scientific name and local name, ecology and distribution) is held in a computer in the Botanic Garden. The system uses maps to show how common a species is in a given area, how it grows, in what type of habitat and the plant parts used. This data is necessary for research, education and conservation.

Threats and Opportunities

In many parts of the region both traditional and modern health systems exist. Normally, people consult both systems, though for different reasons and during different stages of the disease. Certain diseases are believed to be better treated by one of these systems. Despite the increased interest in traditional health care, forms of true cooperation between the two systems are rare. Traditional healers may refer to modern medicine, but the reverse is rarely the case. There is a tendency in the western-oriented biomedical tradition to focus on risks and play down indigenous medicine and the expertise of traditional healers (De Smet, 2000). We cannot deny the drawbacks of traditional medicine, which include incorrect diagnosis, imprecise dosage, low hygiene standards, the secrecy of some healing methods and the absence of written records about the patient. The heightened interest in herbal medicine in recent years has also resulted in the emergence of quackery in urban areas. Though these is certainly cause for concern, it is unfair to pass judgment on the traditional healing systems on the basis of their worst outcomes.

Indigenous knowledge represents a precious, invisible link between regions and cultures, its resources and the store of experiences nurtured by the specialist in the community. The adoption of new practices and the dominant western systems of learning and scientific investigation appear to threaten these indigenous knowledge systems (Gareth, 2000). Both new and traditional inputs are essential within these indigenous developments; however, constant assessment and incorporation of new phenomena characterize all knowledge systems. New techniques should therefore serve to describe, analyse, validate and classify the beliefs and processes of the traditional knowledge system. Such validation according to Gareth (2000) can confirm the long process of observation, analysis and evaluation that determines each unique culture. It may also represent the basic point of reference in the process of exchange between western biomedicine and the local traditional healer..

There is need to stimulate local people and traditional health practitioners to evaluate the strong and weak aspects of their own knowledge and practices. This is certainly a sensitive issue. Can we assume that outsiders or western biomedical practitioners have the capacity and sensitivity to assess traditional knowledge and technologies? What methods exist to test and improve indigenous knowledge with a spiritual dimension?

Traditional healers are the principal professionals in rural health care services. The investigation noted that most traditional healers are willing to learn more about western medicine and to cooperate to some extent with

their biomedical counterparts. They presume that this may increase their prestige, recognition and income.

Despite rhetoric from the Ministry of Health, well-functioning programmes of collaboration between western and traditional health systems have been relatively scarce. The feeling among traditional medical practitioners is that such pilot projects have failed as a result of opposition from biomedical establishments. Moreover, some traditional healers often do not want to be incorporated in the western-oriented primary health care system as community health workers. They fear that this would look as if they accepted the superiority of western medicine, alienating themselves from their traditional roots. Their clients might feel that the healer has lost control over the total healing process and therefore is a quack.



Photo: A traditional healer demonstrates the correct use of a condom: an example of collaboration between western and traditional health systems.

Conclusion and Recommendations

Since different paradigms of health and illness stand in the way of real integration of the two systems, western biomedicine and indigenous traditional medicine may remain apart as two parallel systems. There is need to research for methods of testing and refining and validating indigenous knowledge in traditional medicine in order to support the process of integration. This will require a thorough understanding of indigenous

practices. In this process reluctance to share specific indigenous knowledge with outsiders must be understood. The study recommends working within a basic framework of education involving the local individuals chosen from among the sons and daughters of the village or from relatives. This counteracts the suspicion of intellectual piracy. Ethnopharmacology is a form of western science that can bring to light which traditional plants are effective and safe for incorporation into the formal health care system. In this process western drug developers must respect the intellectual property rights of the indigenous users of herbal medicine. They must provide adequate compensation for the sharing of that knowledge, as established in the convention on Biological Diversity. (De Smet, 1999).

If irreplaceable genetic resources are lost, traditional medicines and indigenous knowledge will also disappear. To prevent this from happening, prompt action is required at every possible level: local initiatives, support from non-governmental organizations, universities, Scientific research and active governmental support for international agreements to protect intellectual property rights. *In-situ* and *ex-situ* conservation of medicinal plants must be established in order to highlight the links between people and plants and to show the importance of the plants to human welfare as well as the maintenance of ecological integrity. Future studies should consider ethnobotanical parameters such as known medicinal plant species, specific medicinal uses of plants, species status (wild or cultivated), plant organs used (root, tuber, shoot, exudates, bark, seeds, fruit), and its status of use (used in the past, still in use, used recently). This should be complemented by a detailed understanding of the concept of traditional medicine and a study of the knowledge transfer systems.

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APPENDIX

Medicinal plants of the Mount Cameroon: Ex-situ conservation in the Limbe Botanic Gardens.

Plant species	Life form	Plant parts used	Observations
<i>Afromomum spp.</i>	Herb	Fruit, leaf, steam, seed	Sold in local and regional markets
<i>Alstonia boonei</i>	Tree	Bark, latex, leaves	Bark sold in local markets
<i>Ancistrocladus Korupensis</i>	Climber	Leaves	Preliminary trials by scientists for the cure of AIDS and Cancer
<i>Annickia chlorantha</i>	Tree	Bark, leaves	Sold on local markets
<i>Baillonella toxisperma</i>	Tree	Bark, seed oil	Sold on local markets
<i>Bryophyllum pinnatum</i>	Herb	Leaves, fruit	Not sold in markets
<i>Canarium schweinfurthii</i>	Tree	Fruits, seed, resin Bark	Fruits sold on local markets + high value timber 40.000CFA/m ³
<i>Ceiba pentandra</i>	Tree	Leaves, bark, root	Not sold in markets. Timber sold: 8000CFA/m ³
<i>Cola spp.</i>	Tree	Seeds, leaves, Bark, roots	Sold locally and cola exported to Nigeria
<i>Costus aferker</i>	Herb	Stem, root, leaves Rhizomes	Not sold in markets
<i>Elaies guineensis</i>	Tree	Sap, wood, leaves, Oil and trunk apex.	Oil, kennels, and fruits sold
<i>Eremomastax speciosa</i>	Herb	Leaves	Generally not sold in markets
<i>Garcinia kola</i>	Tree	Seed, root, bark, Latex	Seeds and barks sold on local markets

<i>Garcinia mannii</i>	Tree	Branches for chewing sticks, bark, leaves, latex	Bark sold. There is significant trade in chewing sticks
<i>Kigelia Africana</i>	Tree	Buds, bark, fruits	Commonly sold in markets and regularly bought
<i>Milicia excelsa</i>	Tree	Exudates, bark, leaves, roots.	Not sold, wood used for poles and furniture
<i>Nauclea diderrichii</i>	Tree	Bark, root, fruits	Branches sold for chewing sticks. Valuable timber
<i>Newbouldia laevis</i>	Tree	Bark, root, leaves	Sold in local markets
<i>Physostigma venenosum</i>	Shrubby Climber	Seeds	Not sold
<i>Piper guineensis</i>	Woody Climber	Fruits, seeds, leaves, roots	Commonly sold in local markets
<i>Prunus africana</i>	Tree	Bark	Bark traded in World market
<i>Pterocarpus soyauxii</i>	Tree	Stem, bark, leaves	Leaves sold as vegetable, stem and bark sold
<i>Rauwolfia vomitoria</i>	Tree	Sap, seeds, leaves bark	Sold for industrial transformation
<i>Ricinodendron heudelotii</i>	Tree	Seeds, leaf, bark, root, kernel	Seeds sold widely in markets
<i>Senna alata</i>	Shrub	Leaves, bark	Not sold in markets
<i>Spilanthes filicaulis</i>	Creeping herb	Leaves, flowers	Not sold in local markets
<i>Strophanthus gratus</i>	Shrub	Leaves, roots	Sold in the world market (exported)
<i>Tetrapleura tetraptera</i>	Tree	Fruit, seeds, bark	Fruit sold as a spice. Bark not marketed.
<i>Voacanga Africana</i>	Tree	Seeds, latex, bark Root	Sold to industries. Exported.

Source: Based on the work of Sarah Laird: Medicinal plants of the Limbe Botanic Garden, Mount Cameroon Project, Limbe.

Herbalism and Resources for the Development of Ethnopharmacology in Mount Cameroon Region

Summary

Tropical forests are a biologically lavish and diverse ecosystem with plants whose potential value as a natural pharmacy is yet to be discovered. The native people have for centuries used plants as medicine. There is a need to stimulate traditional healers to evaluate the strong and weak aspects of the indigenous knowledge base and to devise methods to test and improve knowledge. The study uses a combination of this primary and secondary data to provide baseline knowledge on the concept of herbalism, endogenous knowledge of medicinal plants, pharmaceutical uses, marketing status and threats to sustainable development. It establishes an ethnomedicinal plant inventory consisting of a total of 30 plants with major ailments. In terms of life form 70% were composed of trees, 6.6% shrubs, 10% climbers and 13.3% herbs. Some 70% of these plants are locally marketed and 66.6% have other non-medicinal uses. The chapter identifies the stresses and vulnerabilities of the plants and the scope for western biomedical practitioners to assess this traditional knowledge, that is, methods of testing, refining and validating indigenous knowledge in traditional medicine in order to support the process of integration. It finally posits that since different paradigms of health and illness stand in the way of real integration, western biomedicine and African traditional medicine may remain apart as two parallel systems. Hence the need to locate and catalog the plants for the identification of their pharmaceutical properties.

Key Words: Herbalism, Ethnopharmacology, medicinal plants, indigenous knowledge, threats, sustainability.

Introduction

Since the beginning of recorded history all or part of some wildlife plant species have been used as medicine (Miller, 1985). Traditionally, Africans use herbal and animal products as medicines, intoxicants and poisons in their struggle for survival and in their quest for religious experiences. A healer's power is not determined by the number of medicinal plants he or she knows, but by the ability to apply an understanding of the intricate relation between the patient and the world around him or her (Bossard, 1996). Unlike a doctor

trained in western biomedicine, the traditional African healer looks for the cause of the patient's misfortune in the relationship between the patient and the social, natural, and spiritual environment (De Smet, 2000; Erdtsieck, 1997). Many healers are specialized in one or more biomedical aspects, such as herbalism, midwifery or surgery (De Smet, 1999, Juan *et al.*, 2000; Darshan and Bertus, 2000; Ndenecho, 2008).

The United Nations Development Programme estimates the value of pharmaceutical products derived from developing world plants, animals and microbes to be more than 30 million US dollars per year (Cunningham and Saigo, 2001). While these resources have been harvested for hundreds of thousands of years, today's increasing population, changing social, economic and political structures have removed most traditional controls on their exploitation. If wildlife is to continue to make contribution to the development of local economies through the provision of pharmaceutical products, there is need to ensure the survival of species (Arnold and Ruiz-Perez, 1996). There is therefore a need to screen plant samples for medicinal applications and to locate and catalog most of the native flora using local herbal healers who have protected and nurtured the biodiversity on which these products are based (Morris, 1996).

The chapter seeks to provide baseline knowledge on the concept of herbalism, endogenous knowledge of medicinal plants, feasible pharmaceutical uses, marketing status and the main threats to sustainable usage. Such knowledge is necessary for the development of a framework for local community participation in resource management and generation of revenue from medicinal plants.

The study area is located between latitudes 4°N and 6°20'N and longitudes 8°50'E and 10°E. It covers an approximate land surface area of 24, 910 km² (Figure 1). The summit of Mount Cameroon is located at 9°10'E and 4°13'N. The base lies at sea level and the summit at 4095m elevation. Average annual rainfall is 4000mm. It declines inland to 1800mm. Mean temperatures are around 20°C due to the effect of altitude. Soils are andosols supporting lowland submontane and montane tropical forests, and a microcosm of tropical plantation agriculture. In White's phytogeographical classification (1983) the area falls within the afromontane ecoregion. Human activities are fragmenting, degrading and isolating the remaining forest patches despite conservation efforts (Figure 2)

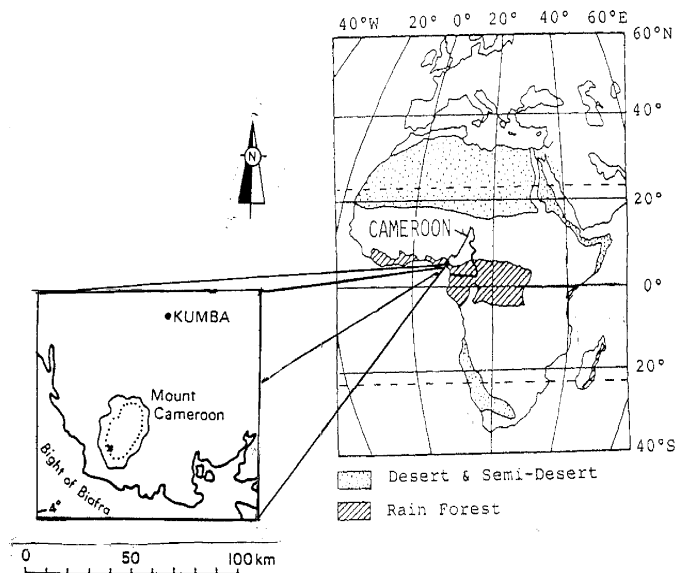


Figure 1: Location of the study area: Mount Cameroon Region.

Methodology

The study employed a combination of primary and secondary data collection methods. The primary data sources consisted of a series of semi-structured and informal interviews with traditional herbalists and staff of the Limbe Botanic Garden, experts of the Institute of Medicinal Plant research in Yaounde and urban and local market surveys. A comprehensive literature review preceded the fieldwork.

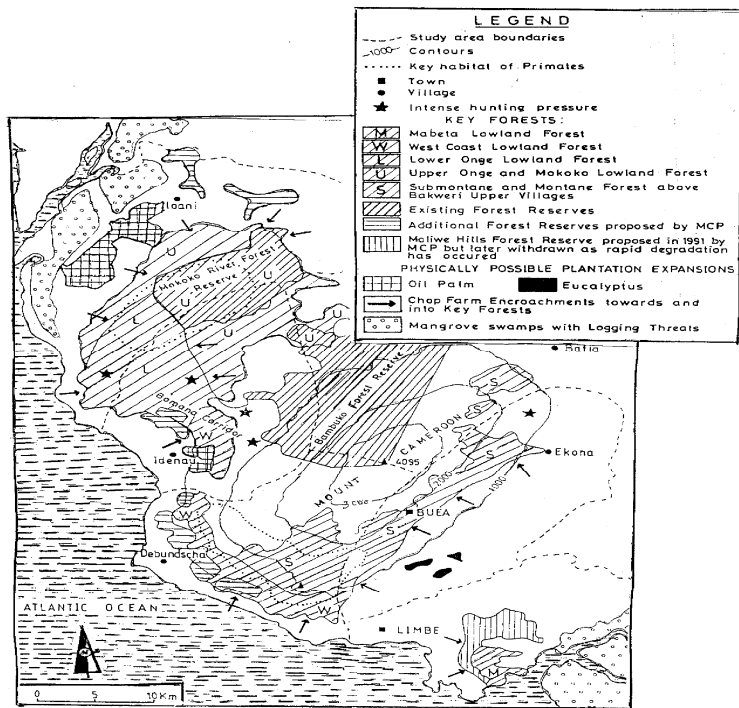
In order to understand and appreciate the traditional health system a participatory assessment of the characteristics of the system was made through dialogue with local people and herbalists in the Bakweri and Oroko tribal areas. A total of 65 people from 15 villages were interviewed: 8 villages from the Bambuko forest area, 4 villages from the Mokoko forest area and 3 villages from the Mbonge forest area (Figure 2). In each village the interviews were conducted with 3 herbal practitioners, who were judged by local people to be actively involved.

As a starting point inventories of local medicinal plants were obtained from the archival material of the Limbe Botanic Garden where these plants are conserved in a herbarium. Information on these plants (use, ecology, local name and pharmaceutical uses) are held on a computer system called BRAHNS. The study had access to these data. In order to obtain ethnobotanical and medicinal data a series of semi-structured interviews

employing an open format that allowed conversational, two-way communication was undertaken in the 15 villages based on the established inventory.

Data on the commercial status of medicinal plant products was obtained through market surveys. A series of informal surveys were undertaken at markets in Fako and Mundemba areas. While these surveys do not comprise a wholly representative assessment of the conditions under which most medicinal plants and their non-timber forest products are traded (particularly with the influence of seasonality) , they do provide a useful overview of products being traded and an indication of extraction pressure.

The data so collected enabled the identification of the scope for testing and refining practices to support the process of the development of ethnopharmacology and the establishment of the feasible links with western medicine.



Source: Balgah, 2001

Figure 2: Distribution of natural habitats for medicinal plants and threats in the Mount Cameroon Region. MCP = Mount Cameroon Project.

Results

The Traditional health system is composed of two main components. These are divination and herbalism:

- **Divination:** Divination and healing are often practised by the same person, who has the power to deal with the spiritual realm. They look for disturbing events in the past, which can cause misfortune if left untreated. Many Africans believe that life forces are manifest in everything. This spirit or power is the essence of every living creature, natural event or inanimate object. These forces all have their own personalities and cosmic place. Therefore the preservation of health is impossible without them. Unlike a doctor trained in western biomedicine the herbalist looks for the cause of the patient's misfortune in the relation between the patient and his social, natural and spiritual environment. Divination and healing are often practised by the same person. He therefore has the power to deal with the spirit realm. It is not surprising that diviners are often listed as the most important traditional healers.

- **Herbalism:** Common ailments, such as headaches or coughs are considered to be diseases with natural causes. Their symptoms are treated at the household level, without resorting to magical practices. For other illnesses, or when a common ailment persists, recourse is sought to divination in combination with herbalism. Herbal medicines are applied to every part of the body in any conceivable way. There are oral forms, enemas, fumes to be inhaled, vaginal preparations, fluids, administered into the urinary tract, preparations for the skin and various lotions and drops for the eye, ear and nose. Table 1 presents a list of medicinal plants, life form; plant parts used and market status. The traditional healer knows the virtues of the native plants. Not everyone can cure everything. According to the lineage, this "depends on the hand of each traditional healer". The belief is that the cure comes from something sacred deep within the healer. For this reason the genuine healers never ask to be paid for their services. Their compensation depends on the discretion of the patient.

Table 1: Medicinal plants of Mount Cameroon area: Plant parts used, life form and market status.

Plant species	Life form	Plant parts used	Observations
<i>Aframomum spp.</i>	Herb	Fruit, leaf, steam, seed	Sold in local and regional markets
<i>Alstonia boonei</i>	Tree	Bark, latex, leaves	Bark sold in local markets
<i>Ancistrocladus Korupensis</i>	Climber	Leaves	Preliminary trials by scientists for the cure of AIDS and Cancer
<i>Annickia chlorantha</i>	Tree	Bark, leaves	Sold on local markets
<i>Baillonella toxisperma</i>	Tree	Bark, seed oil	Sold on local markets
<i>Bryophyllum pinnatum</i>	Herb	Leaves, fruit	Not sold in markets
<i>Canarium schweinfurthii</i>	Tree	Fruits, seed, resin	Fruits sold on local markets + high value timber 40.000CFA/m ³
<i>Ceiba pentandra</i>	Tree	Leaves, bark, root	Not sold in markets. Timber sold: 8000CFA/ m ³
<i>Cola spp.</i>	Tree	Seeds, leaves, Bark, roots	Sold locally and cola exported to Nigeria
<i>Costus aferker</i>	Herb	Stem, root, leaves Rhizomes	Not sold in markets
<i>Elaies guineensis</i>	Tree	Sap, wood, leaves, Oil and trunk apex.	Oil, kennels, and fruits sold
<i>Eremomastax speciosa</i>	Herb	Leaves	Generally not sold in markets
<i>Garcinia kola</i>	Tree	Seed, root, bark, Latex	Seeds and barks sold on local markets
<i>Garcinia mannii</i>	Tree	Branches for	Bark sold. There

		chewing sticks, bark, leaves, latex	is significant trade in chewing sticks
<i>Kigelia Africana</i>	Tree	Buds, bark, fruits	Commonly sold in markets and regularly bought
<i>Milicia excelsa</i>	Tree	Exudates, bark, leaves, roots.	Not sold, wood used for poles and furniture
<i>Nauclea diderrichii</i>	Tree	Bark, root, fruits	Branches sold for chewing sticks. Valuable timber
<i>Newbouldia laevis</i>	Tree	Bark, root, leaves	Sold in local markets
<i>Physostigma venenosum</i>	Shrubby Climber	Seeds	Not sold
<i>Piper guineensis</i>	Woody Climber	Fruits, seeds, leaves, roots	Commonly sold in local markets
<i>Prunus africana</i>	Tree	Bark	Bark traded in World market
<i>Pterocarpus soyauxii</i>	Tree	Stem, bark, leaves	Leaves sold as vegetable, stem and bark sold
<i>Rauvolfia vomitoria</i>	Tree	Sap, seeds, leaves bark	Sold for industrial transformation
<i>Ricinodendron heudelotii</i>	Tree	Seeds, leaf, bark, root, kernel	Seeds sold widely in markets
<i>Senna alata</i>	Shrub	Leaves, bark	Not sold in markets
<i>Spilanthes filicaulis</i>	Creeping herb	Leaves, flowers	Not sold in local markets
<i>Strophanthus gratus</i>	Shrub	Leaves, roots	Sold in the world market (exported)
<i>Tetrapleura tetraptera</i>	Tree	Fruit, seeds, bark	Fruit sold as a spice. Bark not marketed.
<i>Voacanga Africana</i>	Tree	Seeds, latex, bark Root	Sold to industries. Exported.

Table 1 presents the main plant parts harvested. These include fruits, stems, seeds, leaves, barks, exudates, latex, seed oil, resin, roots, rhizomes, sap, kernel, flowers and woody tissues. These are either used fresh or dried for eventual use. When dry, they can be sold on local markets in whole parts

or in powder form. *Prunus africanus* is exported in the form of dried bark. A majority of the plant parts of the other medicinal plants are traded in local markets. In terms of life form the plants are composed of 21 trees (70%), 2 shrubs (6.6%), 3 climbers (10%) and 4 herbs (13.3%). A total of 9 out of the 30 medicinal plants identified (30%) are commercialized, that is, 70% of the plants contribute to local economies, and have therefore attracted research interest in determining their pharmaceutical uses. (Table 2).

Table 2: Plants of the Mount Cameroon region and their indigenous medicinal and pharmaceutical uses.

Botanic name	Indigenous medicinal uses	Pharmaceutical uses
ZINGIBERACEAE <i>Aframomum Spp.</i>	Ritual uses, fruits used to ward off evil spirits and witchcraft, to magnify the effects of other medicines. To treat fever, headache and measles, colds and flu, and to treat wounds.	Most parts of the plant seeds have been shown to contain zenoids ginerol, shagoal and paradol. The seeds of <i>Aframomum denielli</i> obtained from Cameroon contain labdane diterpenoids. The essential oils from the seeds have been shown to kill fungus and bacteria.
APOCYNACEAE <i>Alstonia boonei</i>	Malaria remedies, treatment of swellings, worms and other intestinal parasites, fractures or dislocations and inducing breast milk. Treating rheumatism	It contains several indole alkaloids-echitamine, echitamidine, akuammidine, picraline, quebrachidine and its esters, vincamajine and alstonine. The bark contains triterpenes bamyrene and lupeul and the leaves, ursolic acid.
ANCISTROCLADACEAE <i>Ancistrocladus korupensis</i>	Treatment of measles and	Scientists have proposed that extracts from this plant

	fever, roots boiled and drunk as a laxative	be produced to provide a locally affordable anti-HIV medicine. A few researchers in universities in Nigeria and Cameroon have begun to research this possibility. The Major market for E compounds, however, has been the USA where the bulk of research on Michellamine b has taken place
ANNONACEAE <i>Annickia chlorantha</i>	Yellow fever, jaundice, hypatitis B, malaria, typhoid. Bark used to produce eye drop for conjunctivitis. Ground wood used as dressing for infected wounds. Bark applied to ulcers.	The main alkaloids from the roots and stem barks are quaternary protoberbines; palmatine, bebereline, jatrorrhizine, and columbamine. Palmine has been shown to reduce fever as well as slowing down the arterial blood pressure and the nervous system.
SAPOTACEAE <i>Baillonella toxisperma</i>	Treatment of infertility and gynaecological problems, rheumatic pains and skin inflammation	
CRASSULACEAE <i>Bryophyllum pinnatum</i>	Used for protection to drive away witches, to take oaths and to attract good fortune,	Preliminary clinical work has shown the presence of xanthonenes, flavonoids, anthaquinones and traces of alkaloids. Potent cytotoxic bufadienolides, bryophyllin A and B, have been found

	antiseptic, treatment of boils, skin diseases and conjunctivitis, treatment of inflammatory skin problems, burns and external ulcers.	isolated and found to be toxic to cattle and other farm stock. Cardiaglycosides, known as bryotoxins, are also present. This species should only be used externally.
BURSERACEAE <i>Canarium schweinfurthii</i>	Asthma, piles, stomach problems, jaundice, dysentery, chest pain, cough, skin infections, intestinal parasites.	Contains the terpene phellandrene. The pulp oil of the fruit is about 71% palmitic acid, 18% oleic acid and small amounts of several other fatty acids. The resin contains 8-20% of an essential oil, the main constituent of which is limonene. It is rich in phellandrenes, and also contains resins and a bitter principle. Composition is variable.
BOMBACACEAE <i>Ceiba pentandra</i>	Chest pain, purgative, heart palpitations, diabetes, diarrhea, headaches, rheumatism	
STERCULIACEAE <i>Cola Spp.</i>	Stimulant, wounds and burns, chest pain, rheumatism, stomach problems, used as an enema, cough,	The species in Cameroon contain purines, caffeine and small quantities of theobromine. They also contain two phenolic substances kolatin and kolatein, as well as catechols, epicatechol and kalonin. Prevents tiredness

	menstrual pains, conjunctivitis.	and encourages more sustained muscular effort.
COSTACEAE <i>Costus afer</i>	Fresh wounds, cough and sore throat, bronchitis, asthma, gonorrhoea, high blood pressure, stimulant and aphrodisiac, eye drop.	The genus <i>Costus</i> is rich in steroidal saponins and sapogenins. The rhizome has been shown to contain various sapogenins, namely diosgenin, stigmasterol and costugenin.
ELAIES GUINEENSIS <i>Palmae</i>	Palm oil is used to mix and apply many medicines; palm wine is used to make alcoholic infusion. The kernel oil used to treat convulsion. Young shoots for treatment of hernia and venereal diseases, and swollen liver in children	Palm oil contains, among other things, glycerides of fatty acids with high molecular weights, including oleic acid (40%-50%), palmitic acid (50%), Linoleic acid (6-10%), stearic acid (5-6%), and myristic acid (1-5%). The oil is also rich in carotenoids and sterols.
ACANTHACEAE <i>Eremomastax speciosa</i>	Menstrual pains, gonorrhoea, appendicitis, dry burns, anti-poison, to increase and purify blood.	
GUTTIFERAE <i>Garcinia kola</i>	Stimulant, laxative,	Active ingredients are biflavonoids which produce

	purgative, aphrodisiac, gastric pains, cough, sleeping sickness, tumours, venereal diseases, chewingstick.	the anti-hepatotoxic, anti-viral, adaptogen plague inhibition properties. They also help to clear toxins accumulated from drinking alcohol. It contains the important antimicrobial benzophenone, kolanone. It has been shown to possess remarkable antihepatotoxic activity against a variety of experimental hepatotoxins. Other activities of the biflavonoid mixture include anti-inflammatory, anti-microbial, anti-diabetic, and antiviral properties. The biflavonoids also possess antidiabetic activity.
GUTTIFERAE <i>Garcinia mannii</i>	Chewingstick, laxative, stomach complaints, malaria, cough, joint pains, taken as enema, an aphrodisiac	Flavonoid is the active ingredient
BIGNONIACEAE <i>Kigelia africana</i>	Eye wounds, rheumatism, fever, snakebite, scabbies, waist pain, stomach problems, wounds and ulcers, arthritis.	
ANARCARDIACEAE <i>Magnifera indica</i>	Fevers, stomach problems, diarrhea, typhoid, malaria, filaria,	Its anthocyanidins are active in treating blood vessel troubles, eye complaints and diabetes. The seed active constituents of

	an enema, sore throat, blindness.	magiferin, ethylgallate, and pherynylpropanoids are antibiotic and used against worms.
MORACEAE <i>Milicia Excelsa</i>	Backache, toothache, to increase lactation, purgative, stomach problems, cough, fever, heart burn, heart palpitations, venereal diseases, hepatitis, liver problems, haemorrhoids.	
BIGNONIACEAE <i>Newbouldia laevis</i>	Venereal diseases, malaria, stomach problems, wounds, eye disease, convulsions, an enema, aphrodisiac, to induce breast milk.	The active constituents of the harmane derivative, harmine and harmol, in the bark are thought to create the properties of this species that kill protozoa and worms.
RUBIACEAE <i>Nauclea diderrichii</i>	Typhoid, stomach problems, toothache, caries and septic mouth, malaria, piles, headaches, ease	Alkaloids isolated from species include harmane, pyridine and indole-pyridine alkaloids. Glycol-alkaloids present in the rootbark. These account in part for the fever-reducing and antidepressant

	blood flow, encourage urination, skin diseases, cough.	pharmacological properties of these species.
PHYSOSTIGMA VENENOSUM <i>Legume-papillionaceae</i>	Ritual and ceremonial plant, seeds and used to poison rats and fish	Its poisonous effect is due to its long sedative action on the spinal cord. The lower limbs become paralysed and death occurs by loss of breath and in large dose-heart failure. In addition to physostigmine, the seeds contain eseridine, and several other alkaloids like eseramine, calabarine, and starch. They also yield albumen. Physostigmine use in eye medicine is due to its cell-destroying action – it inhibits the nervous system, thus, allows acetylcholine to exert its full effect on the smooth muscles, glands and heart. It is reported to be an antidote to strychnine, nicotine, curare and atropine. Eseridine is used in dyspepsia and as eye drops in glaucoma.
PIPERACEAE <i>Piper guineensis</i>	Mixing agent for medicines, builds strength, stomach problems, cough, an enema, side pains, regulate menstrual cycle, infectious diseases, gonorrhoea,	Several lignans have been reported including aschantine and yangambine. The roots yield piperine, trichostachine and lignans, and the leaves contain the lignan dihydrocubebin. The essential oil obtained from the berries has been shown to consist mainly of phellandrene, pinene, and limonene. The amides

	syphilis and colds, bronchial infections	contained in the fruit have been shown to possess antimicrobial, anticonvulsant, antihypertensive, sedative, tranquilising and insecticidal properties. High doses have been reported to be toxic.
ROSACEAE <i>Prunus africana</i>	Chest pain, heartburn, madness, fever, aphrodisiac, inflammation, prostate gland and kidney disease.	Contains compounds including sterols in free and glucosylated form, which help subdue fever and infection, pentacyclic triterpenes, with antioedema activity, and ferulic esters of long chain fatty alcohols and esters of fatty acids, with anticholesterolemic activity
LEGUME- PAPILIONACEAE <i>Pterocarpus soyauxii</i>	Camwood used in ritual ceremonies and medicines, cosmetic mixture, side pain, cough	
APOCYNACEAE <i>Rauwolfia vomitoria</i>	Madness, encourage lactation in new mothers, malaria, worms, eye drop, high blood pressure, stomach problems, smallpox, leprosy, jaundice, snakebite, purgative	Of main pharmaceutical interest are the alkaloids reserpine, rescinnamine, ajamaline, ajamalicine and reserpine, which are extracted from the root bark. Reserpine lowers high blood pressure and slows down the heartbeat.

EUPHORBIACEAE <i>Ricinodendron heudelotii</i>	Diarrhoea, stomach pain, “increase blood”, venereal disease, purgative, laxative	
LEGUM-CAESALPINIACEAE <i>Senna alata</i>	An enema to kill worms, gonorrhoea, yellow fever, jaundice, hypatitis, fungal infection, diarrhoea, dysentery, antidote to snake venom	The major constituents are anthrones and anthraquinones, amino acids, and proteins. Research has confirmed the laxative properties. Used to treat fungal infections and a range of skin ailments, most commonly eczema and ringworm.
COMPOSITAE <i>Spilanthes filicaulis</i>	Chest pain, an enema for side pain, eczema, guinea worm, stomach problems, headache, cough, toothache, used to coagulate blood, rubbed on skin as a local anaesthesia.	The flowers contain a local anaesthetic substance, spilanthal, which is isobutylamide of decadenic.
APOCYNACEAE <i>Strophanthus gratus</i>	Heart tonic, ulcers, guinea worm, antidote for the bite of the black-necked cobra.	The seeds yield the cardenolides strophanthins k, g, etc, which act as heart tonics. They contain cardenolides and some of the most important cardiotonics.

LEGUM- MIMOSACEAE <i>Tetrapleura tetraptera</i>	To stimulate lactation, hypertension, stomach problems, convulsion in children, abdominal pain, venereal disease, gonorrhoea, post-partum tonic, jaundice	The saponins and coumanins produce anti-infective, tonic activities. The saponinsides found in the fruit have been shown to be insecticidal. The saponinsides contained in bark and roots have been shown to act on Lumbago and against coughs and fits
APOCYNACEAE <i>Voacanga africana</i>	To promote lactation, toothache, madness, wounds, malaria, syphilis, sores, healing rituals, painkiller	Many indole alkaloids have been isolated from the bark of the stem and the root 4 – 5% total alkaloids from the stem-bark and 5 – 10% from the root-bark. Seeds are currently used in large quantities for the production of a depressor of C N S activity.

Table 2 presents a partial list of the medicinal plants. Hundreds of wild plants have medicinal value but this knowledge base remains secret. Few plants are used to cure a single illness or disease. The preparation of a mixture of several plants is common. These medicinal plants cannot be gathered at any time of the day; they have their proper time. This is because the spirits of the plants can only be found in their “bodies” at certain moments. Moreover, they must never be pulled or torn violently during harvesting; first, the healer must pray to the guardians of the plant using incantations. This mountain is the place with particular strength of the medicinal plants. Table 2 presents the main endogenous uses of the medicinal plants and their role in the traditional health system, and the pharmaceutical uses as determined by researchers of the Limbe Botanic Gardens. The table (2) presents the major diseases for which the plants are used. The main drawbacks of the endogenous uses include incorrect diagnosis, imprecise dosage, low hygiene standards, the secrecy of some healing methods and the absence of written records about the patients. The diagnosis of disease by traditional healers is not limited to direct observation

and tests. Many supernatural methods are also used, such as reading cola nut seeds, an egg or water filled in a clay pot. Despite these worst outcomes herbal medicines are an essential part of traditional healing.

Table 3: Non medicinal use value of Medicinal plants of the Mount Cameroon Region.

Botanic Name	Local Name	Non Medicinal Uses
<i>Aframomum spp.</i>	Bakweri: mbongo	Spice, flavouring.
<i>Anirickia chlorantha</i>	Bakweri: wolole,	Timber, yellow dye, chewingstick.
<i>Baillonella toxisperma</i>	Bakweri: wondololo, Oroko: bo njabe	Furniture wood, veneer, edible oil.
<i>Canarium schweinfurthii</i>	Bakweri: wotuwa, Oroko: bo alo	Timber, fuelwood, resin, used as incense and for mending pots and calabashes, edible oil, edible fruit.
<i>Ceiba pentandra</i>	Bakweri: wuma	Kapok used to stuff pillows, mattresses and for insulin, wood, dye, oil.
<i>Cola spp.</i>	Oroko: ubo,	stimulant and restorative, appetite suppressant, beverages, edible arils, handicraft.
<i>Costus afer</i>	Bakweri: mondanwany,	Edible stem.
<i>Elaies guineensis</i>	Bakweri: liya, Oroko: ndia	Palm wine, oil, soap making, edible fruit, construction wood, handicraft.
<i>Garcinia kola</i>	Bakweri: nyai, Oroko: nye	Alcoholic drink, edible fruit.
<i>Garcinia mannii</i>	Bakweri: njondinga Oroko: esa	Hardwood used for carving and building.
<i>Kigelia Africana</i>	Bakweri: woloulay	tool handles,

		drums, stools.
<i>Milicia excelsa</i>	Bakweri: momangi	Construction wood, edible leaves, pesticide,
<i>Newbouldia laevis</i>	Oroko: wendende,	
<i>Piper guineensis</i>	Bakundi: ndonga, Balung: bi	Spice, edible leaves, leaves used to embalm corpse, oil distilled for perfumery and soap-making, insecticide.
<i>Prunus africanus</i>	Bakweri: wotangu	Handicraft wood, construction wood, charcoal.
<i>Pterocarpus soyauxii</i>	Bakweri: wobwea,	Furniture wood, edible shoots, red dye.
<i>Rauwolfia vomitoria</i>	Oroko: isologo, Ejagham: esaka, Nso: kitong	Live fence, wood carving, firewood, shade tree.
<i>Ricinodendron heudelotii</i>	Bakweri: wojanga sanga, Ejagham: oyok	Flavourings, carving wood, handicraft, musical instruments, oil.
<i>Tetrapleura tetraptera</i>	Korup: ekok,	Spice, oil from kernel used in perfumes.
<i>Voacanga africana</i>	Bakweri: itongongo	Carving wood, wood ash used as salt substitute.

Table 3 presents the non-medicinal use value of the medicinal plants. Of the 30 medicinal plants 20 have non – medicinal uses (66.6%). These include timber and non-timber forest products. These uses support local livelihoods. There is therefore a risk of over-exploitation when a species occurs at low densities or has a restricted natural distribution. The removal of mature individuals from an area also poses a threat to local populations. The marketing of medicinal plant parts is evidence of exploitation pressure. This may have impacts on the sustainability of these plants.

Discussion

Traditional healers are the principal professionals in health care services for the large majority of people in rural areas. Surveys reported by Gareth (2000) and De Smet (2000) show that most traditional healers are willing to cooperate to some extent with their biomedical counterparts. Herbal medicines are readily accepted and widely used in rural areas because they are cheaper than western synthetic pharmaceuticals. The major medicinal uses of the plants identified include fevers, headache, colds and flu, wounds, measles, fractures and dislocations, intestinal parasites, hepatitis B, jaundice, conjunctivitis, hypertension, tooth ache, rheumatic pains, infertility and gynaecological problems, ulcers, skin diseases, burns, heart palpitations, menstrual pains, stomach problems, cough, convulsion, venereal diseases, gastric pains, hernia, arthritis, haemorrhoid, bronchial infections, abdominal pains and madness. A total of 30 medicinal plants were identified with indigenous uses and 22 with established pharmaceutical uses. In terms of life form 70% were composed of trees, 6.6% shrubs, 10% climbers and 13.3% herbs. About 70% of these plants are marketed in rural and urban markets, and 66.6% have non-medicinal uses. This is evidence of exploitation pressure. The main stresses and vulnerabilities are due to the exploitation of timber and non-timber forest products, agricultural encroachment, establishment of forest plantations and climate change. Increased concentrations of CO₂, the primary cause of climate change, are likely to affect the physiology of these montane plants. The exact outcomes are unclear, and will vary from species to species and be affected by factors such as inter-specific competition, physical site conditions and anthropic factors.



Photo: Researcher Joseph Mbafor extracts plant compounds in Cameroon's rain forest. A remedy made from the inner bark of the *Enanda Chlorantha* treats Malaria.

Enthnopharmacology is a form of western science that can bring to light which traditional plants are effective and safe for incorporation into the formal health care system. In this process western drug developers must respect the intellectual property rights of the indigenous users of herbal medicines. They must provide adequate compensation for the sharing of that knowledge. Can we assume that western biomedical practitioners have the capacity and sensitivity to assess traditional knowledge? What methods exist to test and improve indigenous knowledge with a spiritual dimension? New techniques are needed to describe, analyse, validate and classify the beliefs and processes of the traditional knowledge system. Such validation can confirm the long process of observation, analysis and evaluation that determines each unique culture. It may also represent the basic point of reference in the process of exchange between western biomedicine and the local traditional healer.

If irreplaceable genetic resources are lost, traditional medicines and indigenous knowledge will also disappear. To prevent this from happening, prompt action is required at every possible level: local initiatives, support from NGOs, scientific research and active governmental support.

Conclusion

Tropical montane forests constitute a natural pharmacy with a stock of potential medicinal plant species yet to be discovered by modern science. There is a wealth of secret indigenous knowledge on these plants which can be tapped through the collaboration of scientist, herbalists and indigenous knowledge repositories. This will require the training of native people as practical “parataxonomists” to locate and catalog the plants for the identification of their pharmaceutical properties. There is therefore a need to research for the methods of testing, refining, and validating indigenous knowledge in traditional medicine in order to support the process of integration, since different paradigms of health and illness stand in the way of real amalgamation. This could be a good model for scientific information gathering and a way for tropical countries to benefit from these native plant resources. In this way the preservation of the plants will be promoted.

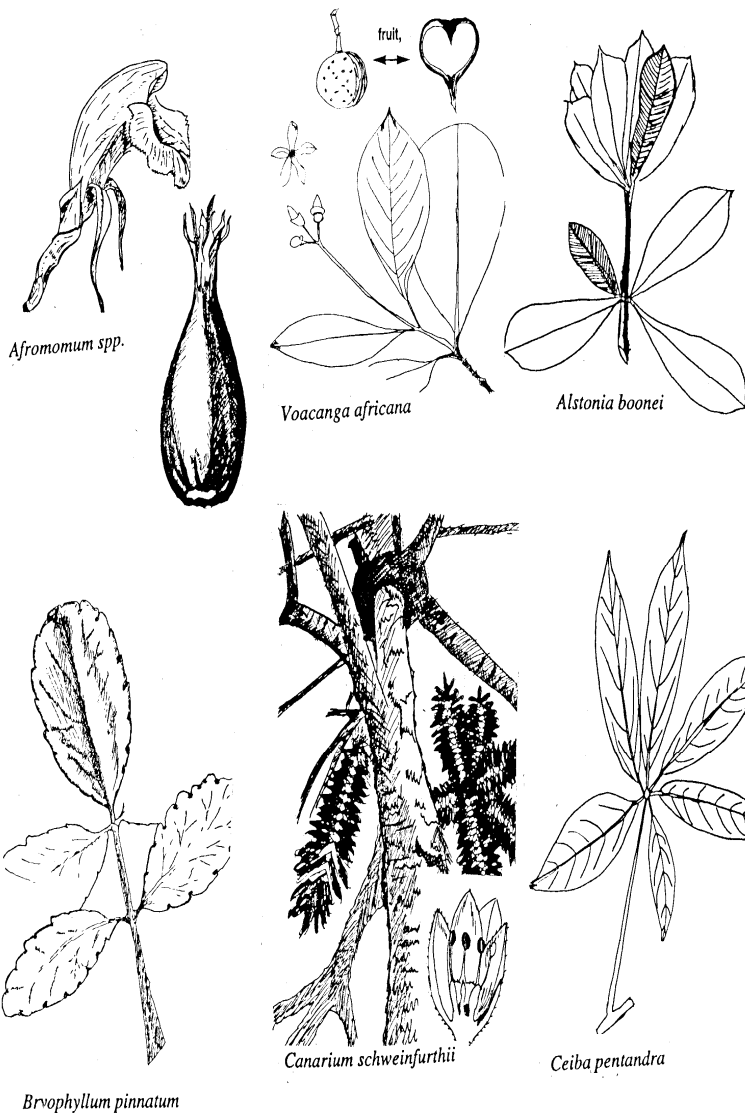
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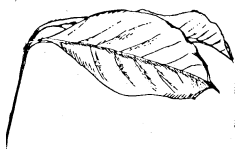
Appendix

Medicinal Plants of Mount Cameroon Region





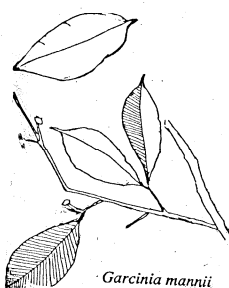
Cola spp.



Garcinia kola



Costus aferker



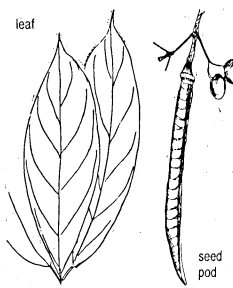
Garcinia mannii



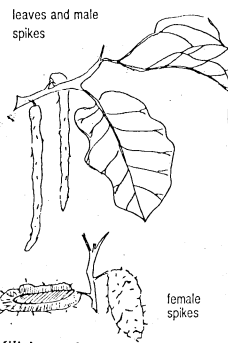
Magnifera indica



Eremomastax speciosa



Kigelia africana



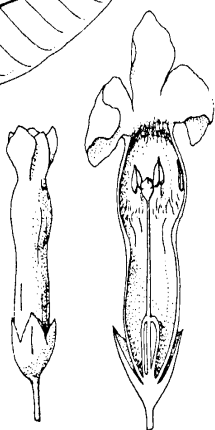
Milicia excelsa

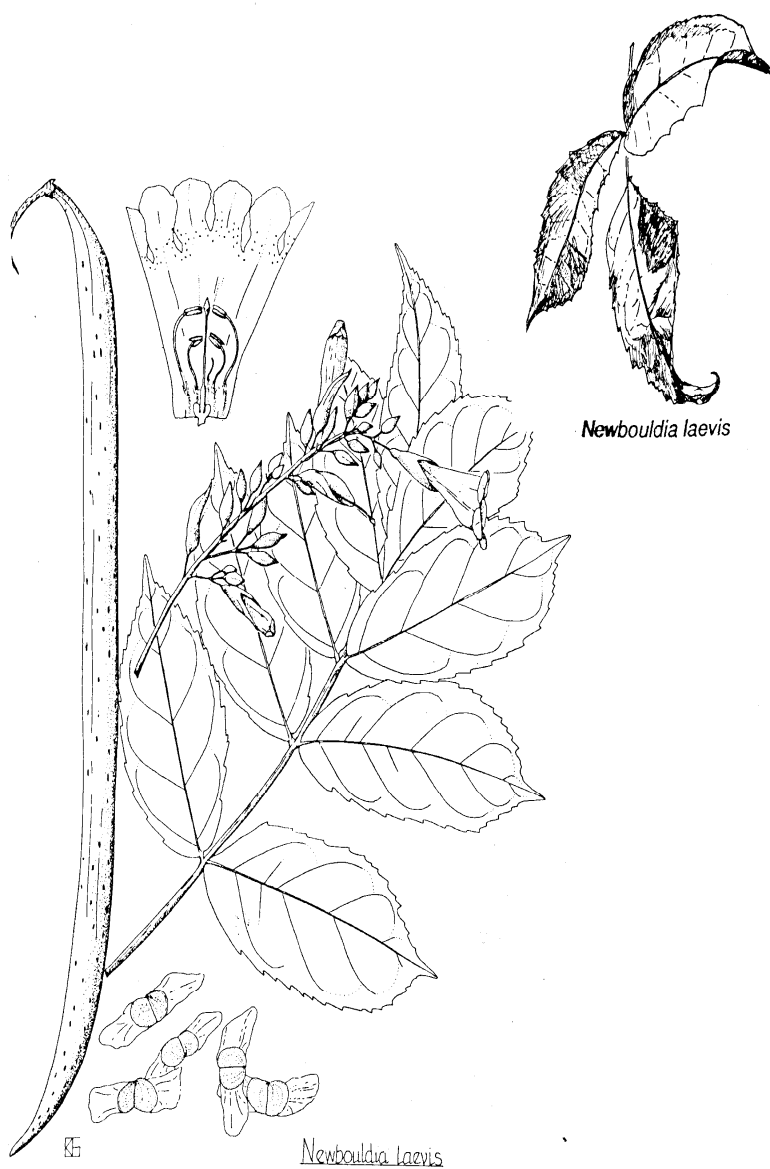


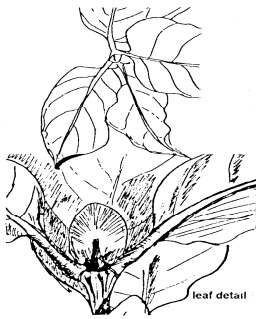
Rauvolfia vomitoria Afzel.



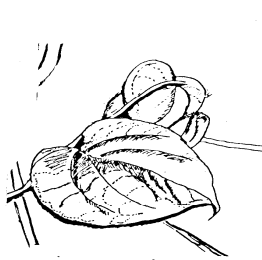
Ricinodendron heudelotii.



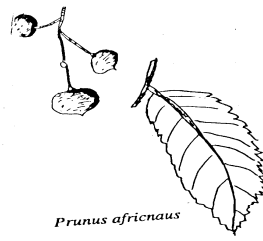




Nauclea diderrichii



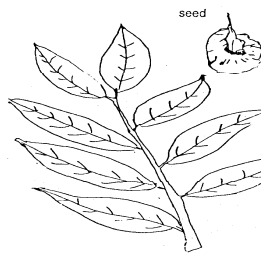
Piper guineensis



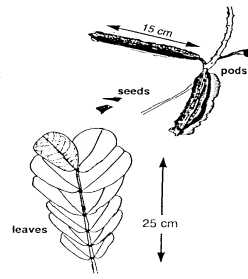
Prunus africana



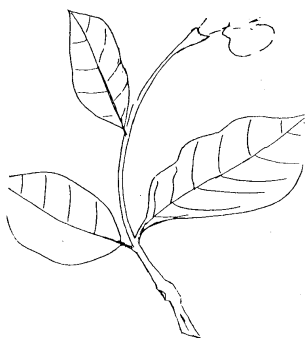
Rauvolfia vomitoria



Pterocarpus soyauxii



Senna alata



Strophanthus gratus



seed pod

Tetrapleura tetraptera



Chapter 5

Indigenous Trees and Shrubs in Silvopastoral Systems of Bamenda Highlands

Summary

Ruminant production in the tropics is characterized by malnutrition during the dry season due to low forage availability and the poor nutritive quality of the forage. Browsers remain green year round and have a potential for improving the productivity of range lands. Due to human population pressure on land, this valuable tree and shrub germplasm may be lost in the medium or long-term. There is therefore a need to conserve these browsers. The chapter uses a combination of primary and secondary data sources to make an inventory of these plants in various range sites and to establish their browse quality and frequency of occurrence. The results show that, at present, the area is equipped with several browsers, the bulk of which are in the transitional range sites. Most of them are of good browse quality. The chapter concludes that more elaborate research will be required to characterize the potentials of these plants and to identify the scope for increasing their utilization efficiency in pastoral livestock production systems of the tropics.

Key Words: Browse resource survey, pastoral livestock production, range land, browse quality, frequency of occurrence, utilization efficiency, degradation, conservation.

Introduction

The roles trees and shrubs play in traditional livestock production systems are varied and have been described by many authors (Asah, 1994; Walker, 1980; Beets, 1989; Dicko-Toure, 1973; Le Houerou, 1987). These varied roles to a large extent depend on the land use practices of indigenous people, population growth and density, traditional beliefs and values, ecology and vegetation of the location, types of enterprises, the level of household income and change in socio-cultural habits. The importance of woody vegetation in traditional farming systems include food, medicine, fodder, fuel wood, timber, soil fertility and erosion control, handicraft, apiculture, shade provision, watershed protection and ornamental.

In tropical Africa where range lands are characterized by wide seasonal variations in pasture ecological resources browsers can contribute to cattle

fodder in sedentary and itinerant systems (Dicko-Touré, 1980). These browses either occur as native vegetation of the area or are introduced into the environment. In ruminant production in tropical Africa, malnutrition during the dry season due to low forage availability and poor quality is the most significant factor affecting production. For pastoral livestock producers the problem is further compounded by expanding agriculture, decrease in pasture productivity in terms of quality and quantity of forage produced, poor animal health and deteriorating watershed conditions.

This chapter makes a pasture ecological zonation of the Bamenda Highlands as a basis for identification and inventorisation of various browse plants per range site. It also establishes the browse quality and the frequency of occurrence. With increased pressure on land and rapid environmental degradation, the scope of improving the utilization efficiency of browse plants in traditional livestock production systems is identified.

The study area is found in the North West Region of Cameroon. It has a land surface area of 17,836km². The area is characterized by very diverse ecological zones described by Keay (1953), Hawkins and Brunt (1965) and Champaud (1973). Topographically, it is a varied relief of mountains, plateaux, valleys and flood plains in intermontane basins. The soils are utisols derived from basalts, trachytes and granites with varying degrees of weathering. Precisely, the soils are acidic, low in major nutrients and have high phosphorus requirements (Yamoah *et al*, 1994). Furthermore, some food crops fields and the main natural pastures are found on steep slopes in upland areas where erosion losses are phenomenal as in decline is soil fertility.

The climate is highly varied and is influenced by topography which ranges from an altitude of 300m to 3010m above sea level. It has been described by Moby (1979) as a tropical montane climate characterized by 1500 to 3000mm of rainfall per year, 0 to 3 dry months; a mean annual temperature of 21°C and a mean annual temperature range of 2.2°C. Moist montane forest is the climax vegetation community of the wetter mountains. Lowland evergreen forest is found at elevations below 300m above sea level. These climax floristic communities have been anthropogenically degraded and what exists today is a complex mosaic of montane woodlands, tree and shrub savanna, grass savanna, farms and fallow fields derived from tropical montane forests. (Nkwi and Warnier, 1982; Ndenecho, 2005).

Pastoralism involves cattle rearing and limited crop production by the Mbororo tribe, the Aku tribe and some native crop farmers. Approximately 60% of the total land area can be used for grazing. This represents a potential of 1,058,914 hectares of natural grazing land out of 1,700,409 hectares. Most rangelands at elevations of 900m above sea level suffer from overgrazing and

dry season forage shortages are common. The grazing system is therefore an extensive system with transhumance as a factor maintaining range ecological stability.

Materials and Methods

Using vegetation-altitude correlation maps established for the region by Hof *et al* (1987), Hawkins and Brunt (1965), Macleod (1986) and Champaud (1973) a pasture ecological zoning of the study area was made and presented in both qualitative and quantitative terms. A combination of field observations and secondary data sources enabled a mapping of the main pasture zones and the land use intensity. This data was then presented in cartographic form. Three main pasture ecological zones were identified. In order to identify the browse resource potentials for each ecological zone. Six transects originating from the high lava plateau (areas above 1600m) and ending in river valleys (areas between 300 and 900m) were used. These coincided with major transhumance routes. Drovers generally transhume with herds ranging from 35 to 60 cattle. Two drovers representing two herds were identified for each route or transhumance zone monitored by a veterinary post. There were each allocated red paint and a brush to mark the stems of the browsed trees and shrubs as they descend from the high lava plateau down to the river valleys and vice-versa. The main transhumance zones monitored were: Ndop plain, Lip plain, Njinikimbi valley, Lower Menchum valley, Baligham and Dumbo. With the assistance of the veterinary technicians samples of the identified trees and shrubs were collected as per ecologic zone using an altimeter to determine the elevation of samples. The samples so collected were forwarded to the herbarium of the Zoo-technical Research station in Bambui for identification by the range ecologists.

The browse quality and frequency of occurrence per range site was determined in qualitative terms:

- The browse quality was classified as:
 - excellent when plants are browsed both in the dry and wet seasons;
 - good when browsed mostly in the dry season; and
 - poor when browsed only in the dry season when forage is burnt and becomes too scarce
- The frequency of occurrence of browse plants on range sites was established as follows:
 - frequent when present in two pasture zones or in one pasture zone and river banks or forest galleries.



Photo: Fulani herdsman on transhumance with his cattle.

- Less frequent when present in restricted sites such as river banks and forest galleries or in one pasture zone.

Data Presentation and Discussions

Table 1: Pasture ecological zonation of the Bamenda Highlands (Area in Km²)

Division	Total area (Km ²)	Zone 1		Zone 2		Zone 3	
		%	Area	%	Area	%	Area
Mezam	1841	-	-	69.5	1279.25	30.5	561.75
Boyo	1636	8.3	136.6	82.4	1347.9	9.3	151.5
Momo	1734	9.3	334	46.3	803.5	34.4	596.5
Menchum	4489	35.7	1603.3	64	2873.7	0.3	11.9
Donga Mantung	4340	34.6	1503.2	54.6	2371.3	10.8	460.45
Ngoketunjia	1117	0	0	88.7	991.4	1.25	125.6
Bui	2252	5.5	124.74	42.8	963.85	51.7	1162.4
Total	17401	21.3	3702	61.1	10630.9	17.6	3076.1
Transhumance		Dry season grazing zones		Transitional grazing zones		Wet seasons grazing zones	
		December to March		Temporal encampment sites		June to December	

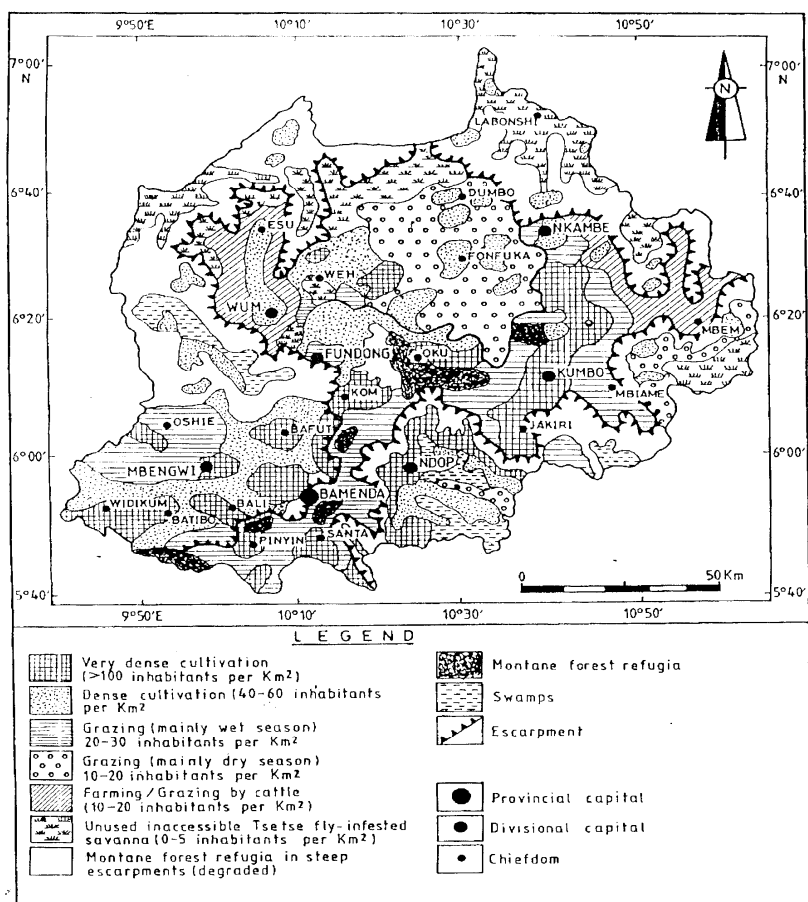


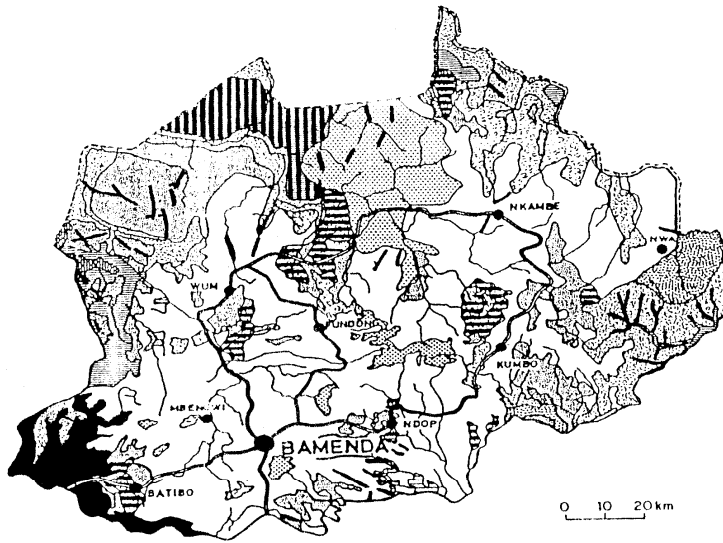
Figure 1: Bamenda Highlands – Land use intensity and the main range sites.

Three main pasture ecological zones were identified. These are (Table 1):

- Zone 1: 300 to 900m above sea level. These are dry season range sites (December to March).
- Zone 2: 900 to 1600m above sea level. These are transitional grazing range sites (April to May).
- Zone 3: Above 1600m. These are wet season range sites (June to December)

These zones constitute the main browse resource niches. The main floristic characteristics identified for the grazing zones are (Figure 2):

Figure 2: Vegetation zones of the Bamenda Highlands



LEGEND

ECO-FLORISTIC ZONES AT LOW AND MEDIUM ALTITUDE (generally below 1800m)

Very moist zone at low and medium altitude (rainfall exceeding 2000mm, 0-1 dry months)

Moist evergreen forest (*Cesalpinaceae* dominant). Trees less tall and *Myristicaceae* more abundant at medium altitude (> 800m).

Sub-humid zone at low and medium altitude (1500-2000mm, 1-2 dry months)

Moist semi-deciduous forest (*Triplachiton scleroxylon*, *Sterculia* spp., *Cola* spp., *Mansonia altissima*, *Celtis* spp., *Terminalia superba*, *Khaya* spp.).

Complex of moist semi-deciduous forest (slopes and valleys) and grassland (ridges)

Woodland savanna (*Burkea africana*, *Daniellia Oliveri*; generally with a dense network of gallery forest.

Tree savanna and shrub savanna (*Terminalia glaucescens*, *Lophira lanceolata*, *Annona senegalensis*) generally with a dense network of gallery forest.

ECO-FLORISTIC ZONES AT MEDIUM AND HIGH ALTITUDE

Sub humid zone at medium altitude (800-1800m, 1400-1700mm, 2-4 dry months)



Moist semi-deciduous forest (*Azelia africana*, *Albizia* spp., *Chlorophora excelsa*).



Degraded semi-deciduous forest



Woodland savanna (*Burkea africana*, *Daniella Oliveri*, *Borassus aethiopum*).



Tree savanna and shrub savanna (*Daniella Oliveri*, *Lophira lanceolata*) generally with a dense network of gallery forest



Grassland.

Montane zone (altitude above 1800m, rainfall exceeding 1500mm)



Evergreen mountain forest (trees generally short; composition variable according to locality; *Podocarpus milanjianus* common).

MISCELLANEOUS



Mosaic of cropland, grassland and savannas



Lake Bamendjing



Gallery forest

• Zone 1: 300 to 900m above sea level. This is a very moist zone. The mean annual rainfall exceeds 2000mm with 0 to 1 dry months. The main ecological niches in the zone are:

- Moist evergreen forest (*Celastraceae* dominant). The trees are not very tall and *Myristicaceae* are more abundant at the 800m to 900m elevation.

- Moist semi-deciduous forest found where the rainfall ranges from 1500 to 2000mm per year and has 1 to 2 dry months. The main tree and shrub elements are *Triplochiton schleroxyron*, *Sterculia* spp., *Cola* spp., *Mansonia altissima*, *Celtis* spp., *Terminalia superba* and *Khaya* sp. There is a complex of moist semi-deciduous forest on valley slopes and grassland on the ridges, woodland savanna (*Burkea africana*, *Daniella oliveri*) generally with a dense network of gallery forest, tree savanna and shrub savanna (*Terminalia glaucescens*, *Lophira lanceolata*, *Annona senegalensis*) generally with a dense network of gallery forest. The main graminiae found in the tree/shrub savannas are *Pennisium purpurum*

25%*m*, *Hyparrhenia spp* 40%, *Andropogon* 10%, *Pennisetum clandestinum* 15% and weeds 10%. These are mainly dry season range sites.

- Zone 2: 900 to 1600m above sea level. These are medium altitude zones. It is sub-humid with 1400 to 1700mm of rainfall per year, and 2 to 4 dry months. The main floristic elements are:

- Degraded semi-deciduous forest;
- Woodland savanna (*Burkea africana*, *Daniellia oliveri*, *Borassus aethiopum*).
- Tree savanna and shrub savanna (*Daniella oliveri*, *Lophira lanceolata*)

generally with a dense network of gallery forest and

- Grasslands (*Sporobolus africanus* 35%, *Pennisetum clandestinum* 15%, *hyperrhenia spp.* 15%).

- Zone 3: These are elevations above 1600m above sea level. The mean annual rainfall generally exceeds 1500mm. This is the montane zone with the following floristic elements:

- Evergreen mountain forest at 1700 to 2100m above sea level. It is dominated by *Schefflera abyssinica*, and *Carapa grandiflora*. Other common trees are *Syzygium staudtti*, *Schefflera mannii*, *Pygeum africanus*, *Rapanea neurophylla* and *Barsama abyssinica*. Small trees include *Nuxia congesta*, *Ixora foliosa*, *Pittosporum mannii* and *Clausena aniseta*. Most of the forest has been degraded to shrub and tree savannas dominated by *Lasiosiphon glaucus*, *Hypericum lanceolatum* *Pteridim aquinum* and numerous forests edge species. Afro-alpine grasslands exist above 2100m altitude and cover the high lava plateau and mountain crests. The grasslands are dominated by *Hyparrhenia spp.* Montane short grassland occurs between 2360m and 3000m elevations. It is derived from bamboo forest and thickets due to fire hazards, deforestation, and retreating tree species. The main grasses include *Eragrostis volkensii* and *Tristachya*. These are mainly wet seasons range sites.

Rangelands in the Bamenda Highlands are found scattered all over the region; from the moist montane forest region of the south (figure 1) where trees and shrubs are regular features; to the open savanna grassland where woody vegetation is sparse. In these diverse ecological circumstances, multipurpose tree and shrub germplasm is extremely varied and reflects to a large extent the differences in ecological factors such as altitude, climate, land use and soils. These remain green all year round.

Table 2: Common browse plants identified in the Bamenda Highlands

Family	Species	Habitat
Anacardiaceae	<i>Magnifera indica</i>	Zone 1
Boraginaceae	<i>Cordia milleniy</i> , <i>Cordia Africana</i>	Zone 3 Zone 3
Celastraceae	<i>Daniellia oliveri</i> , <i>Piliostima thonningii</i>	Zone 1 Zone 1
Vernoniaceae	<i>Veronica amygdalina</i>	Zone 2 and 3
	<i>Veronica leucocalyx</i>	Zone 2 and 3
	<i>Veronica corferla</i>	Zone 2 and 1
Ebanaceae	<i>Dalbergia oligophylla</i> , <i>Diospyros sp.</i>	Zone 2 Zone 2
Euphobiaceae	<i>Bridelia micrantha</i>	Zone 2
	<i>Bridelia sthocarpa</i>	Zone 2
	<i>Antidesma membranacum</i>	Zone 1
	<i>Bridelia grandiflora</i>	Zone 1
Hypericaceae	<i>Parinari spp.</i>	Zone 2
	<i>Psorospermum aurantiacum</i>	Zone 2
	<i>Pseudarthria hookeri</i>	Zone 2
	<i>Psychotria succulenta</i>	Zone 2
Maliaceae	<i>Khaya grandifolia</i> <i>Khaya sp.</i>	Zone 1 Zone 1
Mimosaceae	<i>Albizia adalanthifolia</i>	Zone 2 and 3
	<i>Albizia gumifera</i>	Zone 1, 2 and 3
	<i>Albizia zygia</i>	Zone 1
	<i>Entanda abyssinica</i>	Zone 2
Moraceae	<i>Ficus vogeliana</i> , <i>Ficus spp</i>	Zone 2 Zone 2
Rubiaceae	<i>Canthium vulgare</i>	Zone 2
	<i>Carapa grandiflora</i>	Zone 2
	<i>Cola anomala</i>	Zone 2
	<i>Mitragyna stipulosa</i>	Zone 1
Sapotaceae	<i>Croton macrostachyus</i>	Zone 2
	<i>Nuxia congesta</i>	Zone 2
	<i>Uapaca heudelotii</i>	Zone 1
Papilionaceae	<i>Millettia conraui</i> , <i>Erythrina signoides</i>	Zone 2 Zone 2
Pittosporaceae	<i>Pittosporum mannii</i> , <i>Podocarpus milanjanus</i>	Zone 2 Zone 1
Ulmaceae	<i>Celtis brownii</i> , <i>Vitex sp.</i>	Zone 1 Zone 1
Verbenaceae	<i>Voacanga africana</i>	Zone 1
Total (species)	42 plant species	Zone 1 = 17
		Zone 2 = 25
		Zone 3 = 06

NB: Some plants occur in more than one zone.

Table 2 presents the distribution of browse plants for each ecological zone. 42 trees and shrubs occur on range lands of the Bamenda Highlands as native vegetation of the area (Zone 1= 17, Zone 2=25, Zone 3=06). Some trees and shrubs occur in more than one zone. Shrub species make up the bulk of the browse plants. These are present in relatively high proportion in the transition zones or intermediate altitude zones (zone 2). In terms of species composition, quite a number of different shrub browses and occasionally trees can be found in most grazing areas, particularly in the transition zones, where they form large plant communities. In ruminant production, malnutrition during the dry season due to low forage availability and poor nutritive quality is the most significant factor affecting production in the area (Asah, 1984). For pastoral livestock producers the problem is further compounded by expanding agriculture and the poor quality and quantity of forage, poor animal health and deteriorating upland -watershed conditions. The browse plants are therefore important forage resources for the dry season.

Table 3: Browse quality and frequency of occurrence in the Bamenda Highlands.

Family	Species	Quality	Frequency
<i>Anacardiaceae</i>	<i>Magnifera indica</i>	Good	Frequent
<i>Boraginaceae</i>	<i>Cordia milleniy</i> , <i>Cordia Africana</i>	Poor	Frequent
<i>Celsalpiniceae</i>	<i>Daniellia oliveri</i> , <i>Piliostigma thornningii</i>	Good	Frequent
<i>Vernoniaceae</i>	<i>Veronica amygdalina</i> <i>Veronica leucocalyx</i> <i>Veronica_corferta</i>	Excellent	Frequent
<i>Ebanaeaceae</i>	<i>Dalbergia oligophylla</i> , <i>Diospyros sp.</i>	Good	Less frequent
<i>Euphobiaceae</i>	<i>Bridelia micrantha</i> <i>Bridelia stenocarpa</i> <i>Antidesma membranacum</i> <i>Bridelia grandflora</i>	Good	Less frequent
<i>Hyperiaceae</i>	<i>Parinari spp.</i> <i>Psorosperum aurantiacum</i> <i>Pseudarthria hookeri</i> <i>Psychotria succulenta</i>	Good	Frequent
<i>Meliaceae</i>	<i>Khaya grandfolia</i> , <i>Khaya sp.</i>	Good	Less frequent
<i>Mimosaceae</i>	<i>Albizia adianthfolia</i> <i>Albizia gumfera</i> <i>Albizia zygia</i> <i>Entanda abyssinica</i>	Good	Frequent
<i>Moraceae</i>	<i>Ficus vogeliana</i> , <i>Ficus spp.</i>	Good	Less frequent
<i>Rubiaceae</i>	<i>Canthium vulgare</i> <i>Carapa grandflora</i> <i>Cola anomala</i> <i>Mit ragyna tipilosa</i>	Good	Less frequent
<i>Sapotaceae</i>	<i>Croton macrostachyus</i> <i>Nixia congesta</i> <i>LJapaca hendlotii</i>	Good	Less frequent
<i>Sapindaceae</i>	<i>Aleurotes cordifolia</i> , <i>Allophylus bullatus</i>	Good	Less frequent
<i>Papillionanceae</i>	<i>Millettia conraui</i> , <i>Erythrina signoides</i>	Good	Less frequent
<i>Pittosporaceae</i>	<i>Pittosporum mannbi</i> , <i>Podocarpus milanjanus</i>	Poor	Less frequent
<i>Ulmaceae</i>	<i>Celtis brownii</i> , <i>Vitex sp.</i>	Good	Less frequent
<i>Verbenaceae</i>	<i>Vocanga africana</i>	Good	Less frequent

The bulk of these woody plants are multipurpose trees that do not only serve as animal feed but are used for fuel wood and construction wood. These are rapidly disappearing as a result of exploitation for the above purposes, increasing browsing pressure, expanding crop fields and annual burning. Ndenecho (2005) established that the grasslands in the highlands are derived from moist montane, sub-montane, bamboo and lowland evergreen forests and that pyrogenic and anthropogenic factors have created the complex mosaic of montane woodlands, tree and shrub savanna, and grass savanna. The process of savannization involves the reduction of natural tall forest to a xerophilous environment. This on-going process threatens the browse resource potential of the highlands.

Conclusion

The Bamenda Highlands are endowed with abundant browse plants. These trees and shrubs play a vital role in alleviating dry season forage shortages in traditional pastoral production systems. Most of them are found in the transitional zones (900 to 1600m above sea level) and have a great potential in improving the productivity of range lands. They should therefore be an incentive for ruminant nutrition. This chapter therefore serves as a basis of research for improving the utilization efficiency of trees and shrubs in traditional livestock production systems. More elaborate research will be required to fully characterize the potentials of these plants. There is the need to establish their potentials in maintaining animals in the drought period by determining their crude protein 'content. Trends in the region favour the introduction of exotic forages resulting in the neglect of indigenous species that can reverse dry season shortages or malnutrition during the dry season due to low forage availability. With increased human population pressure onland this tree and shrubs germplasm may be lost in the medium or long — term. These plants exist in the wild. Domestication and integration in pastoral livestock production systems should certainly conserve these range resources.

Acknowledgements

This chapter pays tribute to Asah Henry Asah who died shortly after this data was collected and analyzed. The results are reported by Ndenecho Emmanuel Neba. Dear colleague, may your soul rest in peace.

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Chapter 6

Plant Resources for the Development of Ethnoveterinary Medicine in Adamaoua – Bamenda – Bamileke Plateaux

Summary

Pastoralists are people who live in an intimate relationship with their animals. On the basis of myth, the Fulani or Mbororo in Cameroon believe that their primary duty is to serve their cattle. In turn their herds will give them all they need. Consequently, apart from searching for forage for the herds, they also have to take care of animal health. Illness in livestock is explained by natural and supernatural forces. Illness caused by natural forces is the result of disturbance in the physiological equilibrium of the animal. The chapter overviews the disease perception by the pastoralist, the indigenous knowledge systems on ethnoveterinary medicine and the plant resources available in the Guinea-Savanna areas of Cameroon. It concludes that due to western education and the adoption of modern pharmaceuticals this indigenous knowledge base is rapidly being eroded. It finally recommends a framework for the promotion of ethnoveterinary science and its integration in modern veterinary practices.

Key Words: Pastoralist, indigenous knowledge, ethnoveterinary medicine, plant resources, scientific evaluation.

Introduction

Animal health is a major constraint to livestock production in tropical countries. In mountain environments their remoteness, isolation, marginalization and poverty render modern veterinary inputs and services not readily available. When available they are very expensive. Mountain environments are also characterized by poor communication infrastructure, the lack of diagnostic veterinary laboratories and frontline veterinary staff. Under these circumstances, traditional health care practices have been developed by pastoralist over the millennia. Ethnoveterinary medicine is practised by the Mbororo or Fulani tribe. These are pastoralists in the Bamenda Highlands, Bamileke Plateau and the Adamawa Plateau. This is an animal health care system based on indigenous knowledge that is unique to the culture of pastoralists. Such knowledge is traditional and has been developed and validated by indigenous people through the millennia. This knowledge depends on native trees and shrubs that are today threatened by

rapid westernization and anthropogenic degradation of the useful medicinal plants. The chapter overviews the disease perceptions of pastoralists and makes an inventory of the medicinal plants and their uses.

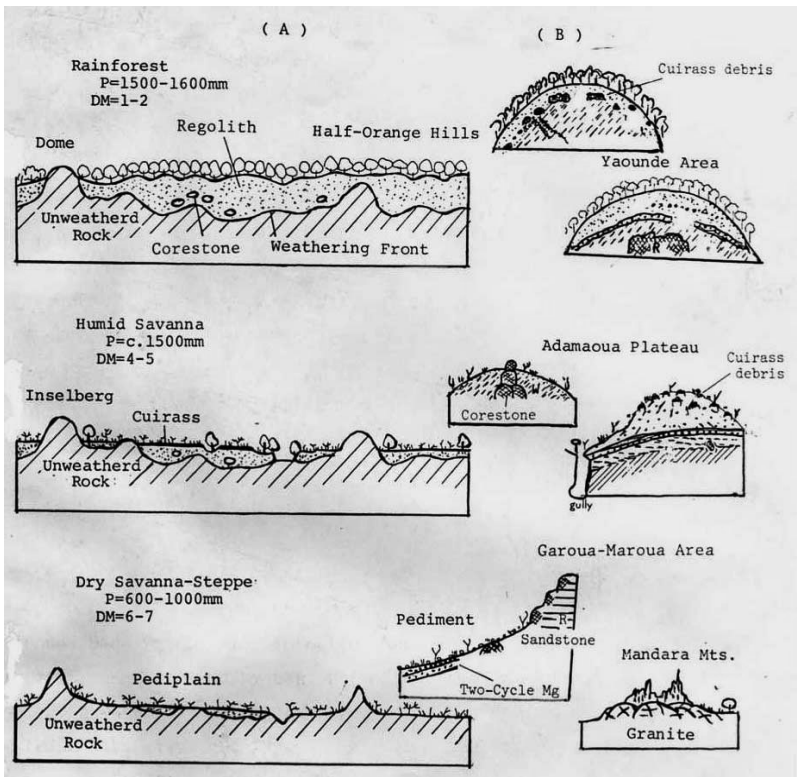
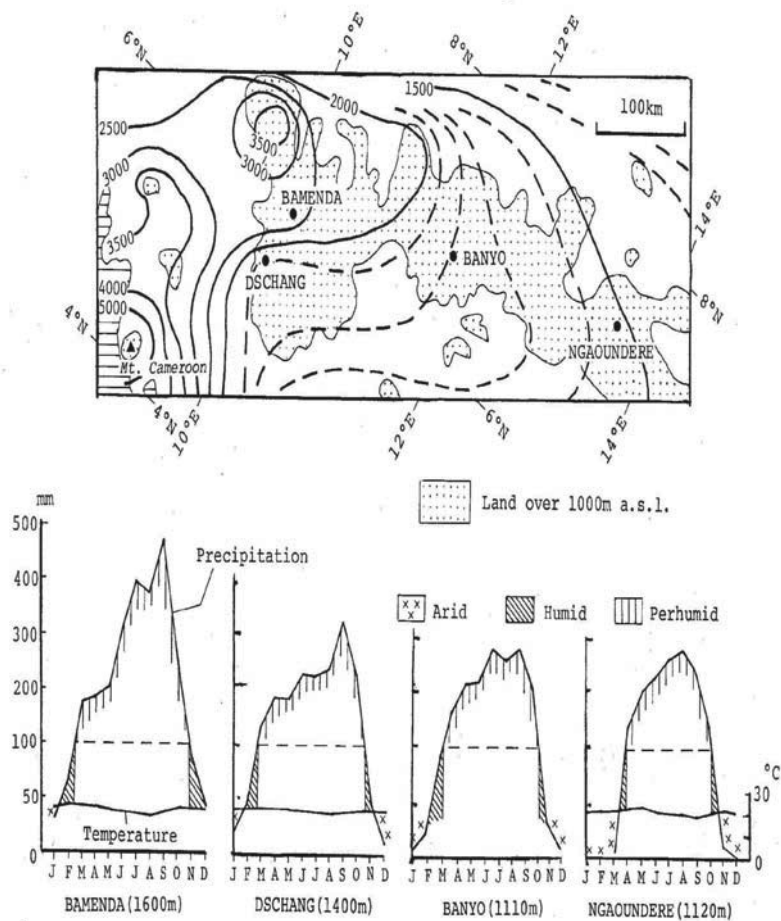


Figure 1a: Regional variation in landscape in Cameroon according to climatic and ecological conditions. (A): modified form Demangeot (1976) which is based on Thomas (1974); B: modified from Kadomura (1977). P: mean annual rainfall (1931-1960); DM: number of dry months with monthly rainfall of less than 50 mm. Multipurpose use of some trees allows their preservation in the landscape.

Figure 2: Climatic condition



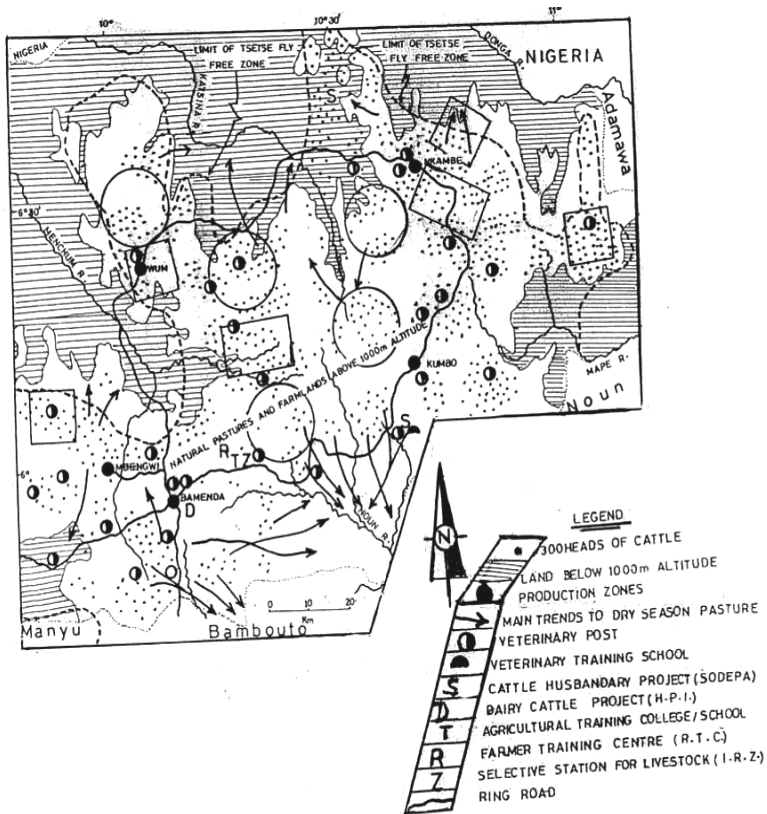


Figure 1c: Bamenda Highland natural pastures showing the distribution of cattle and reas critically invaded by: (a) *Chromolina odorata* and *Spondiathus preussi* (squares), *Pteridium aquilinum* (circles), *Solanum spp.* (rectangles).

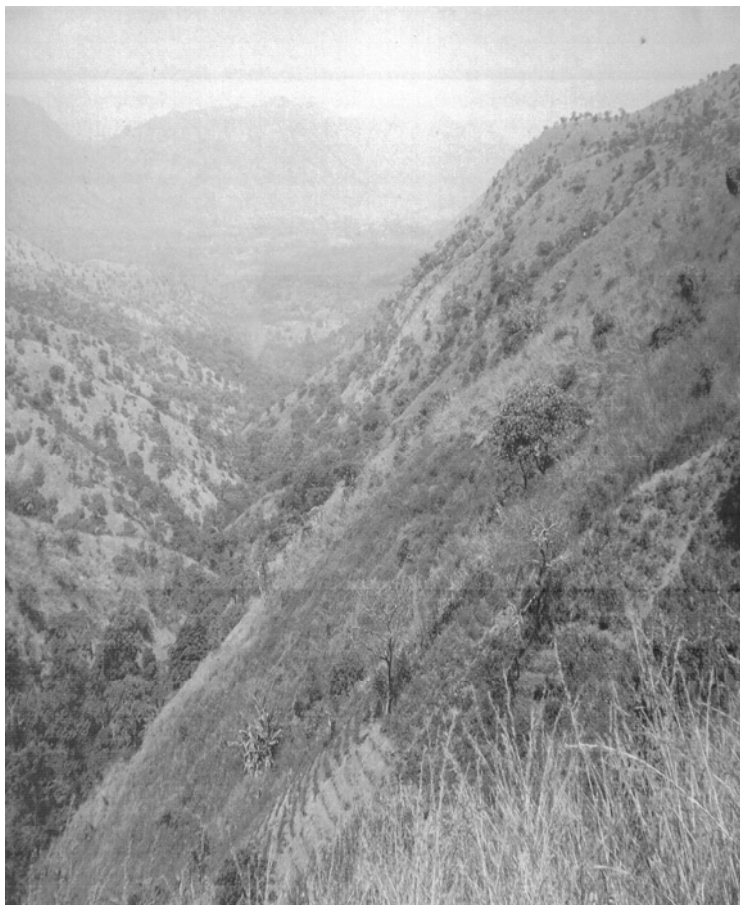


Photo: Valleysides in the Bamoun Plateau, c. 10km north of Foumban.
(November 1984; Photo by T. Tamura)

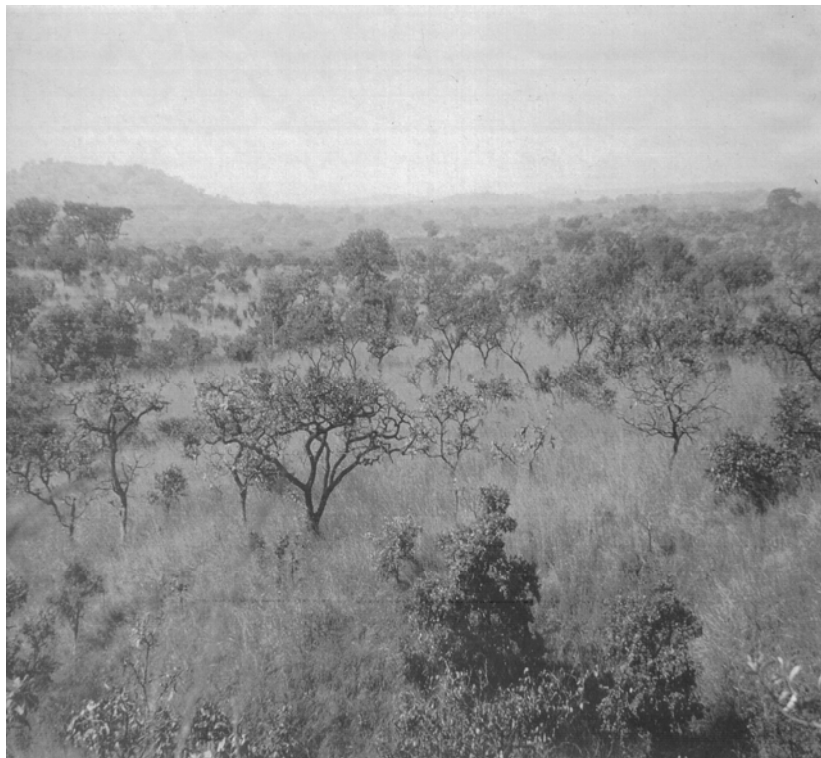


Photo: Wooded savanna c. 30km east-southeast of Banyo, Western Adamaoua. (November 1984; Photo by T. Tamura)

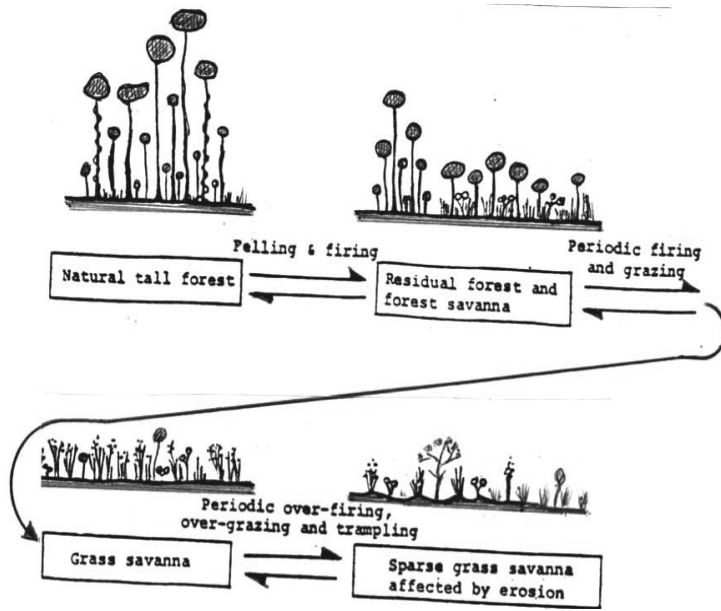


Figure 1d: Dynamic relationship between human impact and process of savannization in the Highlands (modified after Haruki, (1984). The result is wooded savannas with trees and shrubs.

The West Cameroon Highlands are composed of the Bamenda Highlands, Bamileke Plateau and Bamoun Plateau (Figure 1). The Adamawa or Adamaoua Plateau branches from the Bamoun Plateau east – northeast at the northeast end of the West Cameroon Highlands. Both the highlands and the plateaux are horst-like mountains mostly with elevations of 1000m above sea level. The whole area takes the form of gently undulating plateaux composed of Precambrian granitic, migmatic and crystalline rocks. These are, in some places, overlain by volcanic rocks of the ages ranging from the Cretaceous to the Quaternary and / or Tertiary. These rise above the gently undulating plateaux, and the highest one, Mount Oku, reaches 3010m above sea level. There are also small volcanic cones of presumably Late Pleistocene to Holocene age in several areas. Major intermontane plains include the Ndop plain in the central part of the West Cameroon Highlands, the Tikar plain between the Western Highlands and the Adamaoua Plateau, and the low plateaux and plains around Tibati which are sometimes not considered as part of the Adamaoua.

This is an ample rainfall area in the Sudano-Guinean Savanna Zone (see photographs). This high rainfall is the result of orographic factors and the south westerly monsoon from the Gulf of Guinea. The annual rainfall and the length of the rainy season decrease northeastward (Figure 2). At

Ngaoundere mean annual rainfall is 1550mm and the rainy season lasts 8 months. These rainfall conditions do not seem to reject the existence of montane forest. The actual distribution of moist, montane cloud forest is restricted to high mountains, steep slopes, deep intermontane valleys and escarpments. Most of the Adamaoua Plateau is dominated by shrub and tree savannas. The northern part of the West Cameroon Highlands is characterized by almost tree-less grasslands within a mosaic of cultivated fields and is known as the “Grassfields”. Although this area receives abundant rainfall (above 1800mm / year) in more than 10 months cloud forests are restricted to high mountains, steep slopes and escarpments. The southwestern part of the study area is the Bamileke Plateau. This is a landscape of agroforestry homegardens and hedges or fence enclosures. Bamoun Plateau constitutes the southeastern part of the Western Highlands. It has a “Grassfield” landscape.

The above vegetation characteristics are considered to have been formed under intense grazing, burning and farming pressure (Letouzey, 1968; Hurault, 1975; Boutrais, 1974; Hawkins and Brunt, 1965). Some trees and shrubs found in the area are of ethnoveterinary importance. Over the last two decades scientists of the Institute of Zootechnical and Veterinary Research in Bambui and the Heifer Project International (International NGO) have been collecting some data on indigenous knowledge of these trees and shrubs for integration in the animal health programme (Ndi, 2001).

Animal Disease Perception by Pastoralists

The pastoral tribes in the area are the Fulbe and Fulani. Illness amongst humans and livestock is explained by natural or supernatural forces. Illness caused by natural forces is the result of a disturbance in the physiological equilibrium of the individual. Illness can also be caused by supernatural forces and here witches and other agents, such as gods or evil spirits, are involved.

The ethnomedicine amongst these pastoral tribes has a category of “ills” that is engendered by evil forces or the violation of a taboo. These “ills” are different to specific “diseases”. Disease is conceptualized as hot, cold, or contagious. Evidence suggests that, when applied to livestock, the category hot refers to contagious diseases such as anthrax or blackquarter. More chronic conditions such as parasitism or nutritional deficiencies fall into the cold category.

Accordingly, there are also two options for treatment. Common diseases, such as diarrhoea, cough, fractures and birth problems, fall within the domain of the ethnoveterinarian or village animal healer. This person will

treat animals in a rational way, either with herbal preparations or western medicine.

On the other hand, if there is a unexpected outbreak of an unfamiliar diseases, a spirit-medium will be consulted. There are therefore two types of diagnosis:

- The first type is based on direct observation and some empirical examinations to access the mood of the animal, its temperature, the colour of its urine and its faeces, as well as specific symptoms such as foaming at the mouth.
- The second type of diagnosis is based on magico-religious elements, like reading the colanut cotyledons, leaves of plants thrown on the ground, stones thrown on the ground, broken eggs, interpreting dreams, extraordinary events, or omens. When the illness affects large domestic animals this type of diagnosis is adopted.

Changing Dynamics In Diseases Perception

The pastoralist way of life is under pressure. Attitudes towards livestock change with each new generation. Population growth and the invasion of grazing grounds have changed the pastoral way of life and today more and more pastoralist are entering the wage economy. Consequently, livestock treatment in pastoral societies is a mixture of old and new. Traditional medicines and techniques are often substituted by modern veterinary drugs and vaccines. Apart from their useful effects, the growing demand for western pharmaceuticals has been responsible for eroding traditional authority structures and social roles in animal health care. The herbs, trees and shrubs are also being anthropogenically degraded. If this continues, a wealth of indigenous knowledge would have been lost.

Natural Products and Spiritual Forces

The traditional healing practices make use of the application of natural products and the appeal to spiritual forces. The main natural products are:

- **Plants:** These are the most used ingredients in the preparation of medicines. Plant parts such as leaves, bark, fruits, flowers, and seeds are included in preparations.
- **Edible earth and minerals:** Edible earth, especially from termite and ant hills, is commonly used in preparations. An example of an edible earth is limestone.

- **Parts and products from animals:** Parts and products from animals, like skin and hides, bones, milk, butter, urine and dung are other ingredients.

- **Other ingredients:** Honey, vegetal oils and butters, and salt are used both for their healing as well as their preservative properties.

Spiritual forces are called by prayers during rituals. Animal husbandry is strictly ritualized. The rituals include invoking the gods by dancing, and making animal sacrifices, reciting phrases from the Koran and incantations. Rituals, incantations and prayers are made to special medicinal plants and special ingredients. During the collection and use of some medicinal plants the ritual practices include:

- **Strict respect of time of collection:** Collection and preparation is done on special days at particular hours of the day.

- **Special initiation:** Collectors of medicinal plants undergo training and initiation rites.

- **Offering of sacrifices:** Before the collection of some medicinal plants, special sacrifices have to be offered.

- **Respect of a code of conduct by collector.**

Processing Of Medicinal Plants

The most common forms of preparations are:

- **Powder:** Barks, roots, leaves and entire plants are dried and pounded to form a powder. The powder can be fed to animals directly, mixed in salt or prepared in other forms.

- **Poultice:** Adding hot water to plant material in powder form makes a poultice or paste. The paste is then applied to the affected area. Poultices are used in inflamed areas, bruises, irritations, as well as to extract pus, toxins and imbedded foreign particles in the animal's skin.

- **Ointment and cream:** These are made by mixing finely powdered plant materials on extracts with butter or vegetable oils. The ointment is applied to affected areas such as sprains and rashes.

- **Decoction:** One or several plant materials are chopped into small sizes and added to water, and boiled in a clay pot.

- **Infusion:** Boiling water is poured into a container in which powder or chopped plant parts are put. In this way the medicinal components are released. The water is then filtered and served to the animal.

- **Tincture:** Mixing water, alcohol and plant materials produces a tincture. The plant materials are left in the tincture for several days as required. The tincture is then filtered for both external and internal use.

- **Fumigation:** Dry or wet plant material is burnt in a clay pot and the smoke is positioned to engulf the animal. Fumigants are commonly used against ectoparasites such as tse-tse flies.

Natural Preservatives

Preservatives are used to store medicines longer. Some preservatives also have medicinal properties. The most commonly used preservatives and excipients are:

- **Alligator pepper** (*Aframomum melegueta*): It activates medicines and also acts as a preservative.

- **Ginger:** Mixtures including ginger store longer.

- **Honey:** It acts as a major medicinal component and a preservative in fresh plant residues, decoctions and powders.

- **Vegetable oils and butters:** These are added to powders or decoctions together with limestone and boiled to release the active ingredients.

- **Wax from the plant *Daniellia oliveri*.** The wax from this plant is burnt together with medicinal powder in a container.

- **Limestone:** In concoctions or decoctions, it helps to break down the plants to release active ingredients, making the medicine more effective.

- **Fat from cattle:** It is used to preserve medicine by mixing powders with it. It is also used to facilitate the burning of plant materials in fumigation.

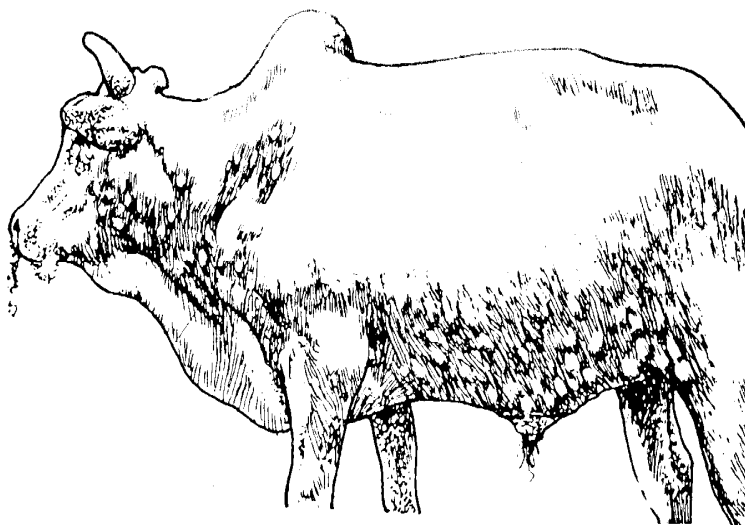


Figure 2: Skin lesions, caused by lumpy skin disease: Treatment is composed of a powder of *Khaya anthoteca* bark, *Psorospermum febrifugum* bark, *Ricinus communis* seeds and limestone mixed in butter. The paste is applied to the skin.

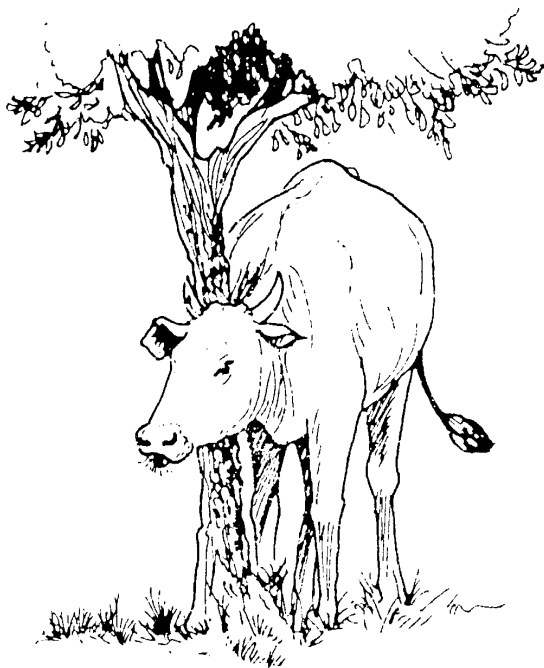


Figure 3: Animal affected by ringworm. It suffers from itch. Treatment is composed of *Phaseolus vulgaris* seeds and *Henrixygia weluitchii* leaves, boiled in water and honey, filtered and orally administered.

Administration Methods

The most common methods of administration of medicines are:

- Drenching: This involves oral administration of medicines in liquid form using calabashes.
- Salt and mineral licks: Powders are mixed with salt and mineral licks.
- Bath: Washing the animal with decoctions or infusion in the treatment of ectoparasites and some infectious diseases.
- Fumigation: The smoke kills ectoparasites such as lice, ticks and flies.

Diagnosis of Disease

The ethnoveterinarian has a holistic view of the animal and searches for the cause of a disease in relation of the patient and the social, natural and spiritual environment. Diagnosis is generally carried out by using senses, like taste, touch, smell and sight, as well as supernatural methods such as

consulting the spirits, oracles or divination. He also has a deep understanding of the sign of good health and the general signs of diseases. This indigenous knowledge has been gained through centuries of experience and handed down through informal training and initiation. Tables 1 and 2 present the medicinal plants and the diseases they can treat.

Table 1: Medicinal plants, cow diseases and plant organs used in the Guinea Savanna area of Cameroon

S/N	Scientific name	Common name	Fulfulde name	Diseases	Plant organ
1	<i>Ademium obesum</i>	Desert rose		Ectoparasites	WP
2	<i>Allium Cepa</i>	Red onion	Albassa	Cowdriosis	B
3	<i>Aloe barbadense</i>	Aloe	Kiruma	Wounds	L
4	<i>Aloesecundiflora</i>	Aloe		Castration	L
5	<i>Anogeissus leiocarpus</i>	Chewstick tree	Kojoli	Diarrhoea	B
6	<i>Arachis hypogea</i>	Pea nut	Biriji	Agalatia, infertility in cows	N
7	<i>Aspillia africana</i>	Wild sunflower	Sonyo-nai	Wounds, snake bite	L
8	<i>Azadirachta indica</i>	Neem tree	Dogonyaro	Ectoparasites	SD
9	<i>Bridelia ferruginea</i>		Buduudi	Ectoparasites, Diarrhoea	B
10	<i>Carica papaya</i>	Pawpaw, papaya	Gondahi	Agalatia, Retentio secundinarium	L
11	<i>Carissa edulis</i>	Natal plum		Stomach + intestinal worms	R
12	<i>Citrus aurantifolia</i>	Lime	Lemuihi	Brucellosis	B
13	<i>Clematis hirsute</i>	Virgin bower	Pitanndewol	Mastitis	L
14	<i>Clematopsis scabiosifolia</i>		Mairero	Poor mothering	L
15	<i>Crinum glaucum</i>		Gaadal	Snake bite	WP

16	<i>Crinum kirkii</i>	Pajama lily	Gaddal Kossam	Agalatia (reduced milk)	WP
17	<i>Crossopteryx febrifuga</i>	Ordeal tree	Rimajogohi	Brucellosis	B
18	<i>Curcubita maxima</i>	Pumpkin	Pumkin	Stomach + intestinal worms	L
19	<i>Dissortis Perkinsae</i>		Bodehon	Diarrhoea	R
20	<i>Emilia coccinea</i>	Tassel flower	Ndanhora	Wounds, snake bite	L
21	<i>Hemizygia melwitschi</i>		Dutalhi	Ectoparasites	L
22	<i>Hibiscus esculentus</i>	Okra	Kubeje	Retentio secundianarium	F
23	<i>Khaya anthoteca</i>	African mahogany	Kahi	Dermatophilosis, Tympany, Diarrhoea, Brucellosis	B
24	<i>Kigelia africana</i>	Sausage tree	Jillahi	Brucellosis	F
25	<i>Lantana trifolia</i>	Lavender popcorn		Lungworms, Retentio secundinarum	F
26	<i>Mucuna puriens</i>	Velvet bean	Kararawol	Snake bite	L
27	<i>Myrsine africana</i>			Diarrhoea	L
28	<i>Nicotinia tabacum</i>	Tobacco	Taaba	Ectoparasites	L
29	<i>Parkia biglobosa</i>	African locust bean	Daddawa	Poor mothering, coudriosis	C K
30	<i>Paullinia Pinnata</i>	Hippocola	Shedewol	Cowdriosis	S T, L
31	<i>Phaseolus vulgaris</i>	Common bean	Nyebbe	Ectoparasites	S D
32	<i>Pilostigma thoningii</i>	Camel foot	Barkehi	Thelazia (worms in the eye), Diarrhoea	B
33	<i>Psidium</i>	Guava	Goiva	Diarrhoea	L

	<i>guajava</i>				
34	<i>Psorospermum febrifugum</i>		Sawoiki	Ectoparasites, Dermatophilosis wounds	B
35	<i>Ricinus communis</i>	Castor bean plant	Kolakolahi	Wounds, Dermatophilosis	S/L
36	<i>Salix subserrata</i>		Keelehi	Infertility in bulls	L
37	<i>Salvadora persica</i>	Mustard tree		Brucellosis, Retentio secundinarum	R
38	<i>Satureja punctata</i>	Lemon mint	Dutalhi	Cowdriosis (Heart water)	ST, L
39	<i>Schefflera abyssinica</i>		Hoyaahi	Mastitis, Brucellosis	L, B
40	<i>Solanum aculeastrum</i>	Goat apple, bitter apple, poison apple	Gitte-nai	Dermatophilosis	F
41	<i>Tarenna grandiflora</i>		Jagarabuehi	Cowdriosis	L
42	<i>Tephrosia vogelii</i>	Vogel's trephosia, pange	Yomji	Ectoparasites	L
43	<i>Urelytrum digitatum</i>		Nikiti	Stomach + intestinal worms	R
44	<i>Vernonia amygdalina</i>	Bitter leaf	Suwaaka	Stomach + intestinal worms	L
45	<i>Vitex doniana</i>	Meru oak	Bummehi	Retentio secundinarum	B
46	<i>Zingiber officinale</i>	Ginger	Ginger	Diarrhoea	R

Source: Ngeh et al., 2006

ABBREVIATIONS

The following abbreviations are used:

(B) = Bark
 (CK)= Cake
 (F) = Fruit
 (L) = Leaf
 (N) = Nut
 (R) = Root
 (SD)= Seed
 (ST)= Stem
 (I) = Tuber
 (WP)= Whole plant

Table 2: Cow diseases and plants used for treatment

S/N	Common name	Scientific name	Fulfulde name	Plants used for Treatment (S/N)
1	Bone fracture		Yebre	Splint butter, bandage
2	Bloat	Tympany	Guttel	18, 23, 43, 44
3	Broken horn		Tolol	Clay soil, bandage, clean water
4	Brucellosis		Bakkale	12, 17, 23, 24, 37, 39
5	Castration		Tappugo	4
6	Diarrhoea		Saarl	5, 9, 19, 23, 27, 32, 33
7	Flies		Bokkaje	1, 8, 9, 21, 28, 31, 34, 42
8	Heart water	Cowdriosis	Nghabbu	2, 29, 30, 38, 41
9	Infertility		Tablingo	6, 36
10	Inflammation of the udder	Mastitis	Felewre	13, 39
11	Lice		Tendi	42
12	Lumpy skin disease	Dermatophilosis	Ngunya	23, 34, 35, 40
13	Lung worms		Bole fufu	25
14	Pink eye	Kerato conjunctivitis	Nyawu-gitte	Milk and salt
15	Poison in the eye		Tooke ender gitte	Fresh milk
16	Poisoning		Tooke	Charcoal, fresh milk, water

17	Poor mothering		Wanyoye	14, 29
18	Reduced milk	Agalactiae	Dakale	13, 39
19	Retained after birth	Retentio secundinarum	Saggugo	10, 22, 37, 45
20	Ring worm		Sanikoje	9, 21, 31
21	Snake bite		Mentiri	7, 15, 20, 26
22	Stomach and intestinal worms		Bole	11, 18, 43, 44
23	Ticks		Kooti	1, 28, 34, 42
24	Worms in the eye	Thelazia	Gilji-gitte	32
25	Wounds		Rawni	3, 7, 20, 34, 45

Source: Ngeh et al., 2006

Table 3: Plants used for the treatment of diseases and ailments of milking cows

Diseases / ailments	Plants		
	Family	Botanical Name	Fulfulde Name
Mastitis	<i>Anacardiaceae</i> <i>Annonaceae</i> <i>Araliaceae</i> <i>Fabaceae</i> <i>Liliaceae</i> <i>Meliaceae</i> <i>Myrtaceae</i> <i>Poaceae</i>	<i>Lannea kertingi</i> <i>Annona senegalensis</i> <i>Schefflera abyssinica</i> <i>Arachis hypogea</i> <i>Urginea altissima</i> <i>Khaya anthotheca</i> <i>Syzigium guinense</i> <i>Sorgum bicolor</i>	Sonyi Dukuhi Hoyahi Birijii Gaadal doroji Kahi Perki Gawri boderi
Agalactia	<i>Asteraceae</i> <i>Euphorbiaceae</i> <i>Liliaceae</i>	<i>Conyza sp.</i> <i>Euphobia hirta</i> <i>Crinum jagus</i>	Gaadahi Endamhi Gaadal kossam
Mismoothering	<i>Asteraceae</i> <i>Papillionaceae</i> <i>Rubiaceae</i> <i>Combretaceae</i>	<i>Bidens pilosa</i> <i>Desmodium veluntinum</i> <i>Olddenlandia</i>	Battalis Takkohi Sarmelel Bawshihi

		<i>herbacea</i> <i>Terminalia mollis</i>	
Retained Placenta	<i>Bignoniaceae</i> <i>Caricaceae</i> <i>Malvaceae</i> <i>Verbanaceae</i>	<i>Kigelia africana</i> <i>Carica papaya</i> <i>Abelmoschus</i> <i>esculontus</i> <i>Vitex donania</i>	Jillahi Gondahi Kubeeje Bummehi
Brucellosis	<i>Bignoniaceae</i> <i>Mimosaceae</i> <i>Papilionaceae</i> <i>Poaceae</i> <i>Piperaceae</i>	<i>Kigelia africana</i> <i>Dichrostachyus</i> <i>cinerea</i> <i>Enythrina</i> <i>senegalensis</i> <i>Pennisetum glaucum</i> <i>Piper guinense</i>	Jillahi Burli Bobillohi Yadiiri Sitta moosoro
Fertility Promoters	<i>Euphorbiaceae</i> <i>Moraceae</i>	<i>Bridelia ferniginea</i> <i>Ficus elastica</i>	Buduhi Biskehi

Source: Ndi, 2001

Apart from the above identifications, the following plants have been validated for their efficacy:

- **Acaricides / Insecticides:** *Euphorbia kamerunica* (Kerenahi) and *Psorospermum guinensis* (Sawwoiki), *Solanum aculeastrum* (Gitte naii), *Khaya anthotheca* (Kahi), and *Vernonia amygdalina* (Suwaaka).
- **Dewormers:** *Ficus sycomorus* (Ibbi-dannehi), and *Annona senegalensis* (Dukuhi).

Indigenous Knowledge and the Validation Process

There is a wealth of indigenous knowledge on ethnoveterinary science that is yet to be discovered by scientists. Continuous research and validation is required in this domain. This will require an indepth understanding of the indigenous knowledge system and knowledge specialists. The indigenous knowledge system in traditional communities is usually sub-divided into specialized fields. Numerous knowledge holders co-exist and operate in well-demarcated domains. Together these specialists conserve, apply and develop the community's fund of knowledge. Knowledge specialists can be classified into two broad categories. These are the pragmatic and esoteric specialists (Gareth, 2000):

- **The pragmatic specialists:** Their activities are linked firmly to their physical environment, like craftsmen, graziers, farmers, birth attendants, herbalists, veterinarians amongst others. Acquiring goods and services from them may involve prayers, sacrifice, or offerings. These pragmatic specialists may participate in, but generally do not lead these ceremonies. Scientists should seek to target these specialists as partners in research on ethnobotanical studies.

- **Esoteric specialists:** These are the custodians of the oral history, legends and belief system of the community. Such knowledge generally confers prestige and high status on the specialist, who may also be entitled to receive tribute or have significant influence in community decision-making. They generally undergo an initiation process (Kohler and Hanwant, 2000).

Indigenous knowledge of plants represents a precious, invisible link between a region, its resources and the store of experiences nurtured by the pragmatic specialists in the community. The adoption of new practices and predominantly western systems of learning and scientific investigation appear to threaten this indigenous knowledge systems. Both new and traditional inputs are important within endogenous development, however, constant assessment and the incorporation of new phenomena characterize all knowledge systems (Edgar and Nunez, 2000).

The challenge of scientists is to develop new partnerships with pragmatic specialists. There is also a need to develop new techniques that should serve to describe, analyse, validate and classify the beliefs and processes of the traditional knowledge system. Such scientific evaluation and validation of medicinal plants and knowledge systems of local people can confirm the long process of observation, analysis and evaluation that determines the unique culture of the people. It may also represent the basic point of reference in the process of exchange between cultures.

Conclusions

Indigenous ethnoveterinary practices can be tested and refined to support the process of endogenous development. Scientists must therefore make an effort to understand, test and improve those endogenous knowledge practices that have persisted in different locations. Together with pragmatic specialists they should test for efficacy and promote the techniques and plants that have been shown to be effective. Research Institutions and Universities must be implicated to use modern designs to conduct experiments to determine the effectiveness of indigenous practices. Past experiences, however, have shown that it is difficult to present statistically

accepted results. It appears that new methods have to be developed. Participative research programmes must focus activities on traditional animal health practices involving the collection of data on pastoralists' concepts of health and illness in animals. It should also include participative studies to enhance the effectiveness of some promising ethnoveterinarian practices. In this process strategies of western science should be included. In this way medicinal plants for the control of internal and external parasites in cattle have been studied.

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Summary

The use of non-timber forest products (NTFPs) in the tropical rainforest management has received greater attention over the past two decades. They are collected from a wide range of ecotypes such as high forest, farm fallows, otherwise disturbed forest, and farmland for use as medicine, food and barter. People throughout the tropics rely on their harvest and sale for their economic well-being. The chapter uses a combination of primary and secondary data to enhance an understanding of the evolutionary process in non-timber forest product collection and the factors that contribute to the intensification of the harvesting of products, the ethnobotanic and socio-economic characteristics, the factors affecting availability, and sustainability. The chapter concludes that non-timber forest product production is mainly limited to extraction from natural forests although there is a growing interest to domesticate and cultivate the most economically viable species. The intensification of collection and the tendency towards domestication depends on both supply and demand factors. Supply factors include seasonality, regeneration rates, the population of individual species in various ecotypes, ease of access to collectors, as well as access to labour. The demand factors include access to markets and the prices of products. The chapter posits that these factors influence the dynamics of non-timber forest product production and management. The current rate of harvesting economically viable species exceeds the ability of the species to regenerate, and the harvest of a number of species can be regarded as unsustainable. It therefore examines the constraints pertaining to their sustainable and equitable exploitation.

Key Words: Non-timber forest products, availability, harvest, intensification, domestication, sustainability, rainforest.

Introduction

Non-timber forest products (NTFPs) have emerged as a vital income-generating activity in many parts of the world. This has raised concerns of their ecological sustainability (Tewari and Campbell, 1995). Since the early 1990s increased attention has been given to the extraction of non-timber forest products from natural forests as a means of reconciling rural

development and environmental conservation (den Hertog and Wiersum, 2000; Bhatt *et al.*, 2000). Consequently, evaluation of the socio-economic characteristics of non-timber forest product production and assessment of the potential of non-timber forest product extraction for sustained management of natural forests has become an important focus of research (Ros-Tonen *et al.*, 1995); Ruiz-Perez and Arnold, 1996). Non-timber forest products are materials derived from forests – excluding timber but including the following: bark, roots, tubers, corms, leaves, flowers, seeds, fruits, sap, honey, resin, fungi, and animal products (Sunderland *et al.*, 2003).

To enhance understanding of the evolutionary processes in non-timber forest product collection and the factors that contribute to intensification of the harvesting of products, a case study of the ethnobotanic and socio-economic characteristics of non-timber forest products in Takamanda rainforest is presented here. The study identifies the different plant non-timber forest products, plant organs exploited, contribution to the household income, marketing channels and the factors affecting availability and sustainability.

The study therefore seeks to identify the major non-timber forest products, the plant parts exploited and their contribution to the household economy. It examines the basic hypothesis that the extraction of non-timber forest products is a first stage in a process of the gradual domestication of these species which presently suffer from seasonal availability and are threatened by unsustainable harvesting. Domestication is therefore a response to the problem of the availability of these products in the wild. There is a need to regulate the collection of these products and to promote their integration in local farming systems.

Cameroon extends from 2°N to 13°N latitude and between 8°25'E and 16°20'E longitude. The study area is located in the South West Province of Cameroon and is part of the Guino-Congolian forest which has an approximate land surface area of 2.8 million km². Rainfall in this vast forest varies from 1500 to 10.000mm per year, giving rise to a variety of vegetation floristic regions (White, 1983). The region contains 84% of known primates, 68% of known African passerine birds, and 66% of known African butterflies (Groombridge and Jenkins, 2000). For this reason, the Guino-Congolian rainforest is an important focal point for conservation efforts in Africa (Sunderland *et al.* 2003).

Takamanda forest is located between latitudes 5° 59' and 6° 21'N and longitudes 9° 11' and 9° 30'E. It has a land area of 67,599 hectares in the Cross River Valley along the eastern border of Nigeria (Gartlan, 1989). Much of the lowland area in the southern and central parts of the forest is rolling terrain between 100 and 400m above sea level. It rises sharply to an altitude

of 1500m in the northern part. The Cross River and its numerous tributaries drain the area (Figure 1). In general, the area has two distinct seasons with most rainfall occurring from April to November, peaking in July and August with a second peak in September with a total annual rainfall of up to 4500mm. the climate is mainly dry from November to April. January and February usually receive no rainfall. The mean annual temperature is 27°C and the wet season is cooler than the dry season.

There are 43 villages within and around the forest, including 12 villages on the Nigerian side of the border, with a total population of 15, 0707 inhabitants (Schmidt – Soltau *et al.*, 2001). Letouzey (1985) estimates that the human population density is between 6 to 12 inhabitants per km². The dominant tribe is the Anyang, and the main spoken language is Denya. The forest was gazetted as a forest reserve in 1934. As with all gazetted areas in Cameroon, the reserve is managed at the national level by the Cameroon Ministry of Environment and Forests (MINEF). During gazettelement of the reserve, local populations were granted traditional rights to use the forest for their subsistence-based livelihoods. They also have legal rights of passage through the Takamanda Forest Reserve (TFR), and the main travel route is the basis of a strong cross-border trading pattern. Agriculture, hunting, fishing, lumbering, and the gathering of non-timber forest products are widespread throughout the reserve (Mdaihli *et al.*, 2003).

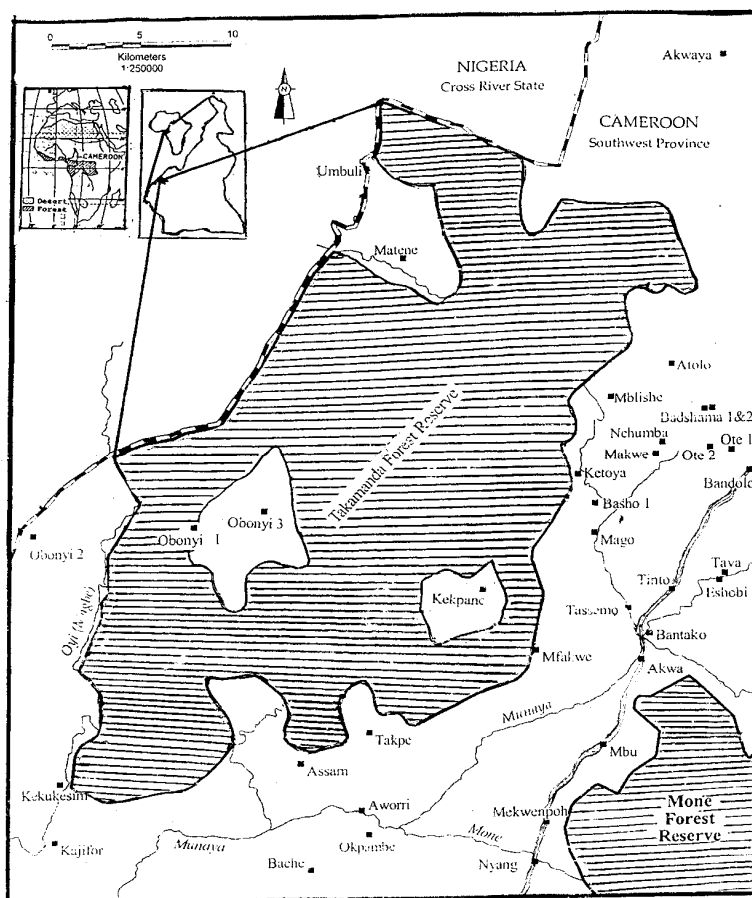


Figure 1: Location of the Takamanda Forest Reserve and the forest-adjacent villages.

Research Methods and Data Sources

The study consisted of a series of semi-structured and informal interviews with resource users and technical staff of the Takamanda Forest Reserve, an inventory - based resource assessment by the botanist of the reserve, and market surveys.

A series of semi-structured interviews - employing an open - format that allowed conversational, two-way communication - was undertaken in the villages of Kajifu, Takamanda, Obonyi 1, Obonyi III, Matene, Mblishi and Nfakwi (Figure 1). In each village, the interviews were conducted mainly with resource users of key non-timber forest products. The users included women and youths.

The resource inventory involved four community – managed forest areas, that is Takamanda, Obonyi I, Matene and Mfakwi (Figure 1). The objective was to identify the useful plants and the plant organs exploited. In common with tested methodology for non-timber forest products in the Takamanda Forest Reserve area established by Sunderland and Tchouto (1999). The inventory consisted of a series of temporary, parallel, 10m-wide transects established along a base-line at predetermined intervals of 100m (10% sampling). Each transect was 1km in length along a pre-determined compass bearing. The goal is to include a full range of forest types along the length of each transect.

Once the transects were established, the enumeration team led by the botanist of the reserve moved slowly along the transect and carefully searched within 5m either side of the central line for individuals of all species selected for the inventory. The 5m distance was checked with a tape. The information was recorded on field work sheets along with the location of the transects. Additional information included the vernacular name, common name, main uses, plant parts exploited and evidence of harvest.

This was followed by informal market surveys at Mbu, Nyang, Mukonyong, Eshobi and Mamfe. These surveys provided a useful overview of products being traded and their contribution to the household income. Seasonal patterns of availability on markets and the impact of harvesting on the sustainability of non-timber forest products in the area were obtained from secondary data sources (Sunderland *et al*; 2003).

Results and Discussions

The forest management condition in Takamanda Forest Reserve is rather complex. Although a government owned forest, it is controlled *de facto* by local forest user groups (FUGs). Regardless of legal title, the forest is treated by local people as a common property resource. Forest officials and villages have two opposing (and sometimes conflicting) views of access rights in the forest. On the one hand forest officials claim authority over the land and frequently take action against unauthorized collection of forest products, while accepting (within limitations) that forest-adjacent villages are breaching the law. On the other hand, indigenous FUGs make their own decisions about forest use while acknowledging that MINEF does impose controls. Existing legislation on forest management at community level has no provision for non-timber forest products. Aside from permits issued by MINEF for the transport and evaluation of *Gnetum africana* (eru), many non-timber forest products, no matter their market value, are not included in the current permit system, which focuses primarily on medicinal plants.

However, MINEF recently created a department for non-timber forest products charged with formalizing revenue collection from the non-timber forest product sector. To date, no policy changes have been proposed.

Table 1: Non-timber forest products of the **Takamanda Forest Reserve** and their local names.

No	Non-timber forest products	Species name	Vernacular names
1	Bush mango	<i>Irvingia gabonensis</i> and <i>I.wombolu</i>	bush mango (vern); ogbono (Igbo); bojep (Boki); eloweh (Ovande); kelua (Basho); gluea (Anyang)
2	Eru	<i>Gnetum africanum</i> and <i>Gnetum buchholzianum</i>	eru (Efik); eru (Ibibio); ukasi (Igbo); ikokoh (Ovande); gelu (Anyang); ecole (Boki)
3	<i>Carpolobia</i> (cattle sticks)	<i>Carpolobia alba</i> and <i>C. lutea</i>	cattle stick (vern); sanda (Hausa); nyerem-mbe (Ovande); okah (Boki); essa (Anyang); fesha (Basho)
4	<i>Randia</i> (chewing sticks)	<i>Massularia acuminata</i> (<i>Randia</i>)	<i>Randia</i> chewing stick (vern); pako (Yoruba); odeng (Boki); egili (Ovande); egili (Anyang); feyili (Basho)
5	Njansang	<i>Ricinodendron bendelotti</i>	njansang (vern); ngoku (Basho); itche (Becheve); ngoge (Boki); ngongeh (Anyang)
6	Bush pepper	<i>Piper guineensis</i>	kakwale (Ovande); iyeyeh (Becheve); ashoesie (Boki); taquale (Basho); acachat (Anyang)
7	<i>Garcinia</i> (chewing sticks)	<i>Garcinia mannii</i>	Igbo chewing stick (vern); osun ojie (Boki); okok (Efik); aku ilu (Igbo)
8	Bush onion	<i>Afrotyrax kamerunensis</i>	felou (Basho); elonge (Becheve); eloweh (Ovande); elu (Anyang)
9	Njabe oil	<i>Baillonella toxisperma</i>	moabi (Trade); bojie = stump, edjie = fruits (Boki); mpoh (Basho)

10	Rattan canes	<i>Laccosperma secundiflorum</i> , <i>L. robustum</i> (large diameter), <i>Eremospatha macrocarpa</i> (small diameter)	gekwiya (Anyang) = large rattan; echie (Anyang) = cane ropes
11	Fever bark	<i>Annickia chlorantha</i>	kakerim (Boki); foukou (Basho); ekwoh (Anyang); ofaechi (Becheve)

Source: 2008 Fieldwork

Table 1 presents an inventory of important non-timber forest products in Takamanda Forest Reserve. The forest-adjacent villages have a long tradition of collecting non-timber forest products as a source of income, for barter and subsistence. The exact number of households involved in their collection is yet to be assessed. It is however an important household activity. Non-timber forest products help to stabilize household incomes because they can be harvested when demand for farm labour is low but when non-timber forest product production is at its peak (Schmidt-Soltau, 2001). It is estimated that 70% of the total population in the area collects forest products for consumption and sale, representing an estimated income of about 850.000 U. S. dollars a year (Ayeni and Mdaihli, 2001), or a mean of 320 U. S. dollars per household. This constitutes 39% of total household income. Some studies also estimate that the majority (68%) of harvested non-timber forest products are sold in home communities, 19% are transported for sale in Nigeria, and 13% are traded in local Cameroon markets (Schmidt – Soltau, 2001; Sunderland, 2001).

Table 2: Takamanda forest non-timber forest products, main markets and their contribution to the average household economy of forest adjacent villages.

No	Common name	Scientific name	Main uses	Percentage contribution to cash income per household	Main market(s)
1	Bush mango	<i>Irvingia gabonensis</i> and <i>I. wombolu</i>	Condiment, soup thickener	58.9	Ikom, Amana (Nigeria) Mamfe
2	Eru	<i>Gnetum africanum</i> and <i>G. buccobolzanum</i>	Edible vegetable	23.3	Ikom, Amana (Nigeria) Mamfe
3	Njansang	<i>Ricinodendron heudelotii</i>	Condiment	6.6	Mbu, Nyang, Mamfe
4	Bush pepper	<i>Piper guineensis</i>	Condiment, leafy vegetable	2.9	Ikom, Amana (Nigeria) Mamfe
5	Chewing stick	<i>Garcinia mannii</i>	Dental hygiene	1.9	Agbokim, Ikom (Nigeria) Mamfe
6	Bush onion	<i>Afrotyrax kamerunensis</i>	Condiment	1.5	Ikom, Amana (Nigeria) Mamfe
7	Bitter kola	<i>Garcinia kola</i>	Stimulant medicinal	1.0	Mbu, Nyang, Mamfe
8	Raffia	<i>Raphia bookeri</i>	Thatching	0.7	Local sale within TFR
9	Hausa stick	<i>Carpolobia lutea</i> and <i>C.</i>	Cattle stick	0.4	Ikom (Nigeria)

		<i>alba</i>			
10	Cola nut	<i>Cola nitida</i>	Stimulant, cultural use	0.4	Ikom, Amana (Nigeria) Mamfe
11	Alligator pepper	<i>Aframomum spp.</i>	Medicinal	0.3	Mbu, Nyang, Mamfe
12	Akpa	<i>Tetrapleur a tetraptera</i>	Condi ment	0.1	Mamfe
13	Njabe	<i>Baillonella toxisperma</i>	Oil	0.1	Local sale, Mamfe
14	Essok	?	Edible	0.1	Unknow n
15	Screw pine	<i>Pandanus candelabrum</i>	Thatching for mats	0.07	Local sale within TFR
16	Rattan	<i>Laccospernia secundiflorum, L. robustum and Eremospatha macrocarpa</i>	Weaving	0.07	Local sale within TFR
17	Ngongo	<i>Marantaceae</i>	Weaving, wrapping	0.06	Local sale within TFR
18	Bush plum	<i>Dacryodes edulis</i>	Edible	0.06	Local sale within TFR
19	Poga	<i>Poga oleosa</i>	Edible	0.06	Local sale within TFR

Source: 2008 Fieldwork and archival material of Takamanda Forest Reserve

Table 2 presents the commercial non-timber forest products, their uses, main markets and contribution to household incomes. (Schmidt-Soltau, 2001; Sunderland, 2001). *Irvingia gabonensis* and *Irvingia wombolu* (bush mango), and *Gnetum africana* and *Gnetum buchholzianum* (eru) combined contribute to 82% of household income. These are the most valuable non-timber forest products in terms of the local livelihoods they support. *Carpolobia lutea* and

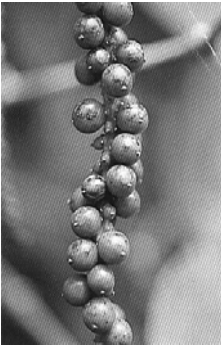
Carpolobia alba (Cattle stick) and Rattan used in weaving handicraft have a relatively high retail value. Prior to the early 1980s non-timber forest products had very little economic value as these were head-loaded to local markets with little spheres of influence. Increasing improvement in access to markets south of the reserve by 1990 facilitated greater access to the local resources. This resulted in a corresponding increase in the harvest and sale of non-timber forest products by both indigenous people and invading Nigerians (Ebot, 2001). This has intensified the harvesting of *Gnetum spp.*, *Carpolobia spp.*, and *Garcinia mannii* to the extent that over-exploitation has been sensed.



A



B



C



D

Figure 2: *Some non-timber forest products of the Takamanda Rainforest:*

A = Five kinds of caffeine-rich cola and their leaves. Cola nuts make up a prized trade commodity.

B = Stripping the bark from a tree for a spice (*bush onion*)

C = Ripe pepper berries await harvest (*bush pepper*)

D = Mushrooms springing up among mosses competing for a stump draw nourishment from decayed wood

Table 3: Non-timber forest products of the Takamanda Forest Reserve, their uses, and plant organs exploited.

No	Scientific name	Plant part used
1	<i>Irvingia gabonensis</i> and <i>L. wombolu</i>	Seed
2	<i>Gnetum africanum</i> and <i>G. buccobolzanum</i>	Leaves
3	<i>Ricinodendron heudelotii</i>	Seed
4	<i>Piper guineensis</i>	Seed, leaf
5	<i>Garcinia mannii</i>	Wood
6	<i>Afrotyrax kamerunensis</i>	Seed
7	<i>Garcinia kola</i>	Seed
8	<i>Raphia hookeri</i>	Leaves
9	<i>Carpolobia lutea</i> and <i>C. alba</i>	Stems
10	<i>Cola nitida</i>	Seed
11	<i>Aframomum spp.</i>	Seed
12	<i>Tetrapleura tetraptera</i>	Seed pod
13	<i>Baillonella toxisperma</i>	Seed
14	<i>Dead woody tissue</i>	Mushroom
15	<i>Pandanus candelabrum</i>	Leaves
16	<i>Laccosperma secundiflorum</i> <i>L. robustum</i> and <i>Eremospatha macrocarpa</i>	Stems
17	<i>Marantaceae</i>	Leaves
18	<i>Dacryodes edulis</i>	Fruits
19	<i>Poga oleosa</i>	Seed

Source: 2008 Fieldwork

* Grows on dead woody material

Table 3 presents the major non-timber forest products, the plant organs exploited. The condiments and soup thickeners such as bush mango, Njansang, bush pepper, bush onion and the seed pod of *Tetrapleura tetraptera* (Nkpa) are dried as a means of preservation for the market. *Aframomum sp.* is medicinal and is either sold fresh or dried, leafy vegetables are sold dried while edible fruits are sold fresh. The seeds that are stimulants are preserved

in a cold and dry environment to cure before eventual sale. The non-timber forest product sector is still very traditional with little knowledge of value addition. To achieve optimum benefits, value addition can aid the rural economy. If these products collected from the wild can be processed local people can realize greater benefits. The products therefore do not generate many benefits to forest users because they do not have adequate knowledge of or access to improved processing, packaging technologies, and marketing. There is however the potential for the government, rural development agency, and non-governmental organization incentives to promote small-scale village enterprises that could greatly increase rural people's incomes. Processing and preservation of products will also alleviate the problems associated with seasonal availability. Such measures can also help to reduce over-harvesting and promote conservation. The processing of spices and condiments is gradually gaining ground in urban centres but not to the interest of forest users, sustainable harvesting and conservation efforts.

Table 4: Seasonality patterns for some key non-timber forest products of the Takamanda forest.

No	Non-timber forest product	Impacts of seasonality	Availability
1	Bush mango	High	Rainy season type (<i>I. gabonensis</i>) available June to September; dry season type (<i>I. wombolu</i>) available February to April
2	Eru	Moderate	All year, although there is less plucking and reduction of supply during early rains as people are occupied with farming
3	Carpolobia (cattle sticks)	Low	All year, although transportation problems in rainy season restrict supply to markets
4	Randia (chewing sticks)		All year, although transportation problems in rainy season restrict supply to markets
5	Njansang	Moderate	Fruits produced during rainy season, but after processing, they can be stored indefinitely
6	Bush pepper	Moderate	Fruits produced in dry season, leaves can be harvested all year

7	Garcinia (chewing sticks)	Moderate	All year, although increased availability in rainy season because of better boat access to remote creeks in forest
8	Bush onion	Moderate	Fruits produced during the rainy season, but after drying, they can be stored for some time
9	Njabe oil	Moderate	Fruits produced in early rains; oil can be stored indefinitely

Source: Archival material of the Takamanda Forest Reserve

Table 4 presents the dynamics of non-timber forest products. According to Ebot (2001), during the last decade, the harvesting of products has increased considerably. The main reason for the intensification of collection has been the considerable increase in the price of non-timber forest products in urban markets such as Mamfe, Bamenda, Douala, Kumba and Limbe. Cross-border trade with Nigeria has also increased. Another factor influencing intensification is the changing labour situation. Villagers are involved in seasonal agricultural work and therefore growing dependence on off-farm income. This increases the amount of time they have for collecting non-timber forest products from the wild, causes over-exploitation and raises the labour cost. It should be worthwhile to invest some labour in establishing non-timber forest product stands in fallow fields, farmlands and private forests. Intensification of harvesting is also influenced by the effects of seasonality. While many non-timber forest products are available for harvest and sale all year round, some are somewhat seasonal, and the economic cycle for many communities relies heavily on the timing of these resources (Table 4). The effects of seasonality are particularly pronounced for bush mango and fruit-producing species and have significant implications for household budgets. Local people are consequently gradually establishing bush mango and *Njansang* plantings.

Tree growing for non-timber forest products is likely to evolve through a number of definable common stages. Where forest cover is locally abundant and population densities are low, tree management exists, but is usually passive. The off-take of tree-based products is usually offset by natural regeneration and tree growth. As population pressure increases, farmers may respond by leaving more trees during land clearance and by more intensively managing the remaining trees by practices such as coppicing, pollarding and pruning, which result in higher total production. As tree resources become increasingly scarce, farmers may take measures to stimulate tree regeneration (Arnold, 1995). This should not be conceived as a

discrete activity but rather as the first stage in the process of gradual domestication of non-timber forest product species.

Table 5: The impact of harvesting of key non-timber forest products and implications for sustainability in Takamanda Forest Reserve.

No	Non-timber forest products	Life form	Part harvested	Impact of harvesting	Level of Sustainability
1	Bush mango	Canopy-emergent tree	Fruits	Low	Relatively sustainable, good regeneration and community-level cultivation
2	Eru	Woody liana	Leaves	Medium to high (depending on technique)	Relatively sustainable if leaves are plucked and the stem is not cut, but destructive unsustainable harvesting is often undertaken
3	Njansang	Canopy-emergent tree	Fruits	Low	Relatively sustainable, good regeneration and community-level “encouragement”
4	Carpolobia (cattle sticks)	Small to medium tree	Stems	High	Highly sustainable because of removal of whole stem, including root collar
5	Garcinia (chewing stick)	Medium to large tree	Bole	High	Highly unsustainable; species has limited geographical range and is in danger of extinction over the long term

6	Randia (chewing stick)	Small to medium tree	Stems	High	Highly unsustainable; population beginning to show a significant decline
7	Njabe	Canopy- emergent tree	Fruits (more commonly timber)	Low to high	Relatively sustainable if harvested for fruits, but unsustainable if harvested for timber
8	Bush pepper	Climbing	Leaves and fruits	Moderate	Relatively sustainable if leaves and fruits are plucked and the stem is not cut
9	Rattan canes	Climbing plants	Mature stems	Low to medium	Relatively sustainable at current levels of harvest

Source: Archival material of the Takamanda Forest Reserve

Table 5 presents the impact of exploitation intensity and its implications on the sustainability of non-timber forest products. But for *Carpolobia spp.*, *Gnetum spp.*, *Garcinia*, *Randia* and *Baillonella toxisperma*, the impact of harvesting is low and relatively sustainable. *Massularia acuminata* (*randia*) suffers from over-exploitation of larger individuals and poor regeneration due to the removal of mature individuals. Exploitation therefore has a long-term effect on the population. There is also the over-exploitation of *Carpolobia spp.* in higher elevations such as Obonyi I and Mfakwe. Mature individuals occur in low densities. Despite healthy regeneration on most sites, the clear absence of larger diameter individuals due to harvesting and removal will certainly affect long-term viability of the population. *Garcinia spp.* used for dental hygiene (chewing stick) is poorly represented at higher-elevations indicating the impact of over-exploitation. There are many reports of local scarcity of *Gnetum spp.* (*eru*) in areas with greater access to markets.

Destructive harvesting practices that are undertaken at low levels of exploitation such as the removal of bark strips (for example, *Annickia chlorantha*) may pose a threat to individual plants but likely not to the population or species as a whole (table 5). In general, many non-timber forest

products such as *bush mango*, *njansang*, *bush onion*, and *bush pepper*, where the harvesting are minimal, are not at immediate risk of being over-exploited, and there are few reports of increasing scarcity of these products (Mgbe, 2008). Destructive harvesting such as felling and removal of individuals is wholly unsustainable. In terms of conservation, over-exploitation is exacerbated when a species occurs in low densities or has a restricted natural distribution such as *Garcinia mannii*. Under such circumstances harvesters must travel deep into the forest or farther and farther into the forest to find desired products. The problem is also exacerbated by agricultural encroachment into the forest.

For key resources such as *eru* and *bush mango* the majority of villages have clear traditional controls on collection from their village forestlands. They exclude “outsiders”. The harvest of other non-timber forest products requires the payment of a token fee to the traditional village institution. Nevertheless, local people do not derive substantial benefits from the non-timber forest product resources because they do not know the actual market – value of the products at the final point-of-sale. A key issue in the control of non-timber forest product resources is the lack of capacity within MINEF. This agency suffers from shortfalls in staff expertise, inadequate basic infrastructure, and logistical support to implement much of the formal forestry legislation.

After an initial stage of open-access extraction from natural forest, there is need for the newly instituted non-timber forest product department of MINEF to control utilization through the definition and control of user rights. These access and control measures should gradually be oriented towards biological practices such as purposeful protection, stimulation of tree growth and production and propagation. For example, community level initiatives at planting *bush mango* have proved successful. There is also an interest to cultivate *eru*. The control of collection techniques in the wild can ensure a sustainable future supply, while the setting of opening dates for collection of non-timber forest products can allow efficient labour investment, higher yield, better quality of products, and a fair distribution of benefits among forest users. The cultivation of non-timber forest products, promotion of local processing and the organization of markets can further production efficiency. These measures should be accompanied by product diversification at the village level in order to avoid heavy reliance on some non-timber forest products and the vulnerability of households in time or season of scarcity.

Conclusions

Rainforests support numerous livelihoods for the rural poor in the tropics. The data shows that non-timber forest product production is mainly limited to extraction from natural forests although there is a growing interest to domesticate and cultivate the most economically important species. The paper also demonstrates that intensification of collection and the tendency towards domestication depends on both supply and demand factors. The supply or availability of non-timber forest products includes ecological factors, such as natural occurrence, seasonality, and ease of access to the species concerned, as well as access to labour. The demand factors include access to markets and the prices. Considering the effects of these factors on the dynamics of non-timber forest product collection and management, the study suggests that extraction of non-timber forest products from natural forests should not be conceived as a discrete activity but rather as the first stage in the process of gradual domestication of valuable non-timber forest product species in view of their importance to household incomes. The current rate of harvest of economically important species exceeds the ability of the species to regenerate, and the harvest of a number of species can be regarded as unsustainable. These include *Carpolobia*, *Massularia acuminate*, *Garcinia*, and *Gnetum spp.* There may also be long-term adverse effects on regeneration from seed removal of *Irvingia Spp.* and the plucking of *Gnetum* leaves for vegetable. Apart from domestication efforts there is an urgent need to devise guidelines for the sustainable management of high-value non-timber forest products. Product diversification and research on new non-timber forest product resources could help reduce the current pressure on available resources of the rainforest. There are significant options for enhancing the income generating potential of these non-timber forest resources through value-addition, and the regulation of harvesting.

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Plant Resources for the Development of Traditional Handicrafts in Bamenda Highlands

Summary

The traditional handicraft industry in developing countries is a potential export generator because it produces inexpensive “ethnic” items, creates jobs, empowers gender and preserves the cultural heritage. Unfortunately, it suffers from competition from industrially produced crafts using enamel, plastics, aluminium, iron and synthetics. The skills, raw materials and iconography for this industry are also fast disappearing. This chapter which is the result of field investigations establishes the main crafts, the raw materials used, an inventory of the plant resources used and discusses issues of sustainability related to availability of raw materials, skills, knowledge of icons and their environmental, cultural and historical linkages. It concludes that the plant resources, knowledge of icons, and skillful craftsmen are in decline due to environmental degradation and erosion of the cultural heritage by modernization. There is a need to regenerate, develop and promote the tight web of natural resource input, outputs into the natural environment, economic opportunities, heritage and cultural expressions. Development action must seek to revive the knowledge and skills, monitoring the raw material sources, determine the impacts of exploitation and to aid in devising guidelines for sustainable management. These linkages can constitute an aspect of sustainable development and environmental management that are culture-driven.

Key Words: Ethnobotanical survey, traditional handicraft, environmental linkage, materials, skills, iconography, sustainable development.

Introduction

During the many centuries before industrially-produced utensils of plastics, enamel, aluminium and textiles people developed them based on local ecology available raw materials, local ideas of beauty and the status system of the society. The skills, materials and the iconography necessary for the sustainable development and promotion of these handicrafts are fast disappearing because the local markets are flooded with industrially-produced articles. Cultural investments, such as historic preservation or

dissemination of traditional skills, can also work to provide economic benefits while preserving connectivity to the past (Chifos, 2006). As an end objective of development, cultural expressions can be more broadly nurtured and disseminated to alleviate poverty and to improve the quality of rural life. Handicraft production is a livelihood strategy that embodies heritage (Nolten and Tempelman, 1986) as well as traditionally having closer ties to the natural environment through the natural materials that are transformed into cultural expressions. Handicrafts, although fraught with issues such as exploitation of labour, skewed distribution of profits along the distribution chain, and increasing competition from mechanized mass production (Scrase, 2003), have been a common choice by development agencies for small scale development improvements. In recent decades, handicrafts have been targeted as a potential export generator, both in conjunction with tourism as well as with global markets for inexpensive “ethnic” items (Chifos, 2006). Economic growth, job creation, gender empowerment, cultural preservation and fair trade objectives have all been linked to the development of the handicraft sector (Agusni and Agusni, 1995; Kaino 1995; Cohen 2000).

The above developments have not fully recognized the environmental link of handicraft production to the existing elements of economic improvement, and social equity. A weak, if non – existent objective is the association of handicraft production with the revitalization and production of natural environmental resources for future generations (Chambers, 1992; Chifos and Looye, 2002; Cohen, 2000; Gallagher, 1973).

The chapter seeks to establish an inventory of the main crafts, their raw materials, vernacular names and ethnobotanical resources used in each ethnic area. It further seeks to discuss issues related to the availability of these raw material inputs, sustainability of skills and knowledge of icons used for the craft, their environmental, cultural and historical linkages.

The area is located between Latitudes 5° 43'N and 7° 10'N and 9° 31'E and 11° 12'E. It broadly coincides with the Bamenda Highlands, which are characterized by plateaux, mountain peaks above 2500 m elevation, deep valleys and intermontane plains. The altitude spans from 300 m to 3011 m above sea level and presents several altitudinal ecological zones: Lowland forests (300 – 800 m), flood plains (800 – 1100 m) savanna woodland (1000 – 1500 m), montane forest (1250 – 2250 m), and afro – alpine grassland (above 2250 m).

Figure 1 presents the distribution of the main ethnic groups and chiefdoms. The average population density is about 96 inhabitants /km² and the landscape is a mosaic of farmlands, natural pastures, clusters of hamlets, remnants of forests, home gardens and urban centres. This is a region where the inhabitants support themselves through farming. The Craftsmen and

Craftswomen are part – time farmers. Craftsmanship is handed down from one generation to another. As part – time farmer they work in partnership with the environment and apply knowledge of useful plants and the weather for the development of handicrafts. They recognize the great variety of local plants which due to forest degradation are becoming scarce (Macleod, 1986; Knopfli; 1998, Ndenecho 2006a, Ndenecho 2006b).

Research Methods

The study is the result of field investigations and secondary data sources. An inventory of the main utensils, their vernacular names and the raw materials used in their production was established based on the work of Knopfli (2001). Craftsmen and women were then identified in the main craft centres per ethnic group and per ecological zone. The field survey involved 4 Chiefdoms in the montane zone, 5 Chiefdoms in the savannah woodlands, 1 in flood plain zones (Ndop plain) and 5 in lowland forest zones. Craftsmen and women involved in wood carving, production of baskets, mats, bags, hats, furniture and utensils were identified and interviewed on the source of their raw materials, ease of availability, skills availability and the motif used on handicrafts. In this way the various plants used in the handicraft industry were identified together with their vernacular names (where possible) and the plant organs extracted and used. Craftsmen and women were further asked to assess the availability of resources in terms of plants materials, skills, iconography and linkages with their local environments, history and the cultural heritage. On the whole 5 wood carvers were interviewed per chiefdom (75), 5 craftsmen involved in mat making per production area (35), 5 involved in basketery and weaving per production zone (35).

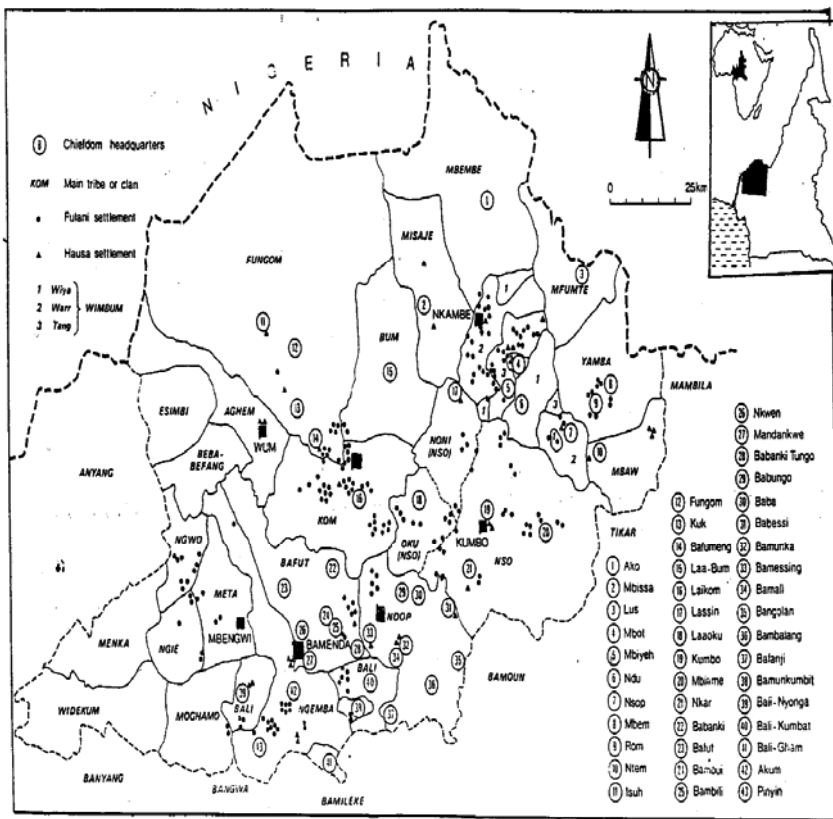


Figure 1: Location of the study area, ethnic groups and the main chiefdoms in Bamenda Highlands.

Presentation of Results and Discussions

The results obtained from the study are composed of:

- an inventory of the main utensils, their vernacular names, the raw materials involved and ethnic area;
- the main tree species used for wood carving per ethnic area and ecological zone;
- the plant materials used in basketery, mat - weaving, furniture, bag and hat- making; and
- a discussion of the availability of materials, skills, knowledge of icons, their environmental, cultural and historical linkages.

Table 1 presents the various utensils among thirteen ethnic groups showing their vernacular names and materials out of which they are made. Apart from earthenware pots the utensils are made either of wood, bark and calabashes. The woody species used as raw materials are presented in table 2. Two types of calabash are found in the area. *Crescentia cujete* is a tropical evergreen tree with large and round gourds. It is found in warmer zones such as Ndop Plain and Esimbi (Lowland rain forest zones). The more common type of gourd is from the plant *Cucurbita maxima*. Its gourds may be pot – bellied with long necks, pot – bellied with short necks and longish with a bottle shape. The utensils are designed based on locally available materials, to do the job for which they are intended and to local ideas of beauty and the social status system of ethnic groups. These utensils which were used before industrially – produced utensils of enamel and plastics are fast disappearing and may be found only in remote communities, museums, craft shops and souvenir shops. The skills required to fashion these utensils are also disappearing. Because of the ethnic identities of the area, the variety of the objects used in everyday life is extraordinarily rich. The favourable raw material for the manufacture of daily utensils is wood. This is a soft warm and live material that can be easily worked and shaped, even with the simplest of tools. Today, the use of these utensils is less frequent because enamel, plastic and aluminium utensils have flooded the market.

Table 1: Main utensils in Bamenda Highlands, their vernacular names and raw materials used in their production

Ethnic groups	Mortar	Pestle	Cooking spoon	Serving spoon	Food and soup bowl	Palm oil container
Aghem	<i>nguh</i> (wood)	<i>tingke-nguh</i> (wood)	<i>taquinko</i> (wood) <i>keba</i> (wood)	<i>tazeako</i> (wood)	<i>wupah, fukonguh, fembongp eh</i> (wood)	<i>fukoi</i> (bark container)
Babun go	<i>iboh kwin</i> (wood)	<i>nkur nchuh</i> (wood)	<i>ide ikwale</i> (wood)	<i>ide teti</i> (wood)	<i>feki-iboh kwin</i> (wood)	<i>fekoh</i> (wotengoh wood)
Bafut	<i>akuechu ge akueana</i> (wood)	<i>nkongach uge</i> (wood)	<i>lu'u</i> (wood)	<i>lu'</i> (wood)	<i>akue ngung</i> (earthenware)	<i>nku mughule</i> (wood) <i>zwie mughule</i> (calabash)
Bali-Nyonga	<i>nka' ngun</i> (wood)	<i>nkonntsu'</i> (wood)	<i>ntunto</i> (wood)	<i>fukob</i> (wood)	<i>kubtu kub</i> (wood) (earthenware)	<i>lo'ngwad</i> (big calabash) <i>ndanngwad</i> (small calabash)
Bamesing	<i>fekue'</i> (wood)	<i>kenchu'</i> (wood)	<i>koebang</i> (wood)	<i>koetam basi'</i> (wood)	<i>kueko, kueto</i> (earthenware)	<i>fukamewo'o</i> (hollow log calabash)
Boyo	<i>fukue'</i> (wood)	<i>akong</i> (wood)	<i>ichimbass</i> (wood)	none	<i>lemei</i> (earthenware)	<i>nkuf</i> (bark container) <i>fuboi</i> (grass jug)
Esimbi	<i>dawonglu</i> (wood) <i>netehuri</i> (wood)	<i>hiture</i> (wood) <i>here</i> (wood)	<i>hapape</i> (wood)	<i>hipe</i> (wood)	<i>sete</i> (wood)	<i>aenu</i> (bark container)
Kidjom	<i>nchue</i> (wood)	<i>nkukelon g</i>	<i>nkukeban</i>	<i>nlue mbase</i>	<i>fekue</i> (wood)	<i>febue</i> (wood)

		(wood)	(wood)	(wood)		<i>dzua</i> (calabash)
Mbum	<i>rzih</i> (wood)	<i>nkong</i> (wood)	<i>chichi-njab</i> (wood)	<i>chichi-gabshi-njab</i> (wood)	<i>rzih-njab</i> (wood) <i>chin-njab</i> (earthenware)	<i>nseh-mgfur</i> (framed calabash with an attached woven neck and a stopper)
Meta'	<i>ngomaban</i> (wood)	<i>eningababan</i> (wood)	<i>fekub fumekai</i> (wood)	<i>fekub</i> (wood)	<i>feku'u</i> (wood)	<i>fundze-muwud</i> (calabash)
Moghamo	<i>ngom</i> (wood)	<i>anung</i> (wood)	<i>ikoeb</i> (wood)	<i>fikoeb</i> (wood)	<i>fiku'me'</i> (wood)	<i>finji-wud</i> (calabash)
Nso	<i>kikong</i> (wood)	<i>kisih-kong</i> (wood)	<i>chih nyo</i> (wood)	<i>chih jav</i> (wood)	<i>lang nyo</i> (earthenware)	<i>kitem keh mingkver</i> (earthenware)
Oku	<i>kenchuk</i> (wood)	<i>mbang kenchuk</i> (wood)	<i>etieh</i> (wood)	<i>kebass</i> (wood)	<i>evuy</i> (wood) <i>esei</i> (earthenware)	<i>feboi</i> (calabash) <i>evuy</i> (wood) <i>kevufekack</i>
Ethnic groups	Camwood storage vessel	Kola nut storage vessel	Mimbo pot	Traditional bed	Treasury receptacle	Mankal a game
Aghem	<i>touketu</i> (earthenware) <i>kebowle</i> (calabash)	none	<i>koi</i> (bark container) <i>twei</i> (earthenware pot)	<i>kweng ndeng</i> (raphia frame) <i>kweng tekue</i> (cane bed)	<i>swibang</i> (earthenware pot) <i>mbui isoo</i> (raphia fibre bag)	<i>bute duu</i> (on the ground)
Babun go	<i>ntuh</i> (wood, earthenware, calash)	<i>keung</i> (basket lined with banana leaves)	<i>yuiking fenkoh</i> (wooden pot) <i>yiking shoh</i> (earthenware pot)	<i>fwang veele</i> (raphia construction) <i>fwang nkongse</i> (raphia with carved bedsteads for	<i>yoh</i> (calabash) <i>yoh fenkoh</i> (carved wooden box) <i>ntuh</i>	<i>ibih</i> <i>kenyiva</i> (wooden board)

				nobles) <i>kung fengkoh</i> (carved wooden bed for chief)	(basket)	
Bafut	<i>nkangbo eroe</i> (wood)	<i>akuka’ nebie</i> (basket lined with banana leaves)	<i>terre mulu’u</i> (earthenw are pot) <i>nku mulu’u</i> (wooden pot)	<i>erku ndengneh</i> (raphia construction) <i>erku ati</i> (wooden construction)	<i>aba alu</i> (raphia fibre bag) <i>nkah</i> (basket with lid)	<i>njang</i> (on the ground) <i>abilie</i> (wooden board)
Bali- Nyonga	<i>to bu</i> (wood)	<i>ku ka’ or nki’</i> (basket)	<i>tadndu’</i> (earthenw are pot)	<i>kun</i> (raphia construction)	<i>ngon</i> (basket with lid)	<i>bomba nmbu</i> (on the ground)
Bamesing	<i>feukuem bu’</i> (earthenw are, wood, calabash)	<i>kae amben</i> (basket lined with banana leaves)	<i>kuemul u</i> (earthenw are pot)	<i>kekun mbeleng</i> (raphia construction)	<i>koembra keih</i> (raphia fibre bag)	<i>moenc haia</i> (on the ground wooden board)
Boyo (Kom)	<i>aghein</i> (calabash)	<i>nkene</i> (basket)	<i>ikueng</i> (earthenw are pot)	<i>kwine leng</i> (raphia construction) <i>kwine chufene</i> (wooden construction)	<i>atern</i> (calabash)	<i>munjan g</i> (wooden board)
Esimbi	<i>haebu</i> (wood, fruit shell)	<i>situro</i> (basket lined with banana leaves)	<i>aeno</i> (bark container) <i>situ</i> (earthenw are pot)	<i>uki-witundu</i> (wooden construction and oil palm leave stems)	<i>kati</i> (basket with lid)	<i>udale</i> (on the ground)

Ethnic groups	Camwood storage vessel	Kolanut storage vessel	Mimbo pot	Traditional bed	Treasury receptacle	Mankala game
Kedjom	<i>fekue fuebyui</i> (wood)	<i>kuki kubih</i> (basket lined with banana leaves)	<i>nkeng</i> (wooden pot)	<i>kukwen telyang</i> (raphia construction) <i>kunkorn</i> (solid wooden bed)	<i>nkyieh</i> (basket with lid) <i>kembo keseise</i> (raphia fibre bag) <i>ketyuom</i> (calabash) <i>kefoh kefe koh</i> (wooden vessel) <i>neteive</i> (bark container)	<i>ah nsei</i> (on the ground) <i>kebang kefe koh</i> (wooden board) <i>kebang kefe koh ketiesekeh</i> (wooden board on stand)
Mbum	<i>ghir-bir</i> (calabash)	<i>nken g-mbih</i> (basket lined with banana leaves)	<i>ntfung-mruh</i> (wooden pot, earthenware pot)	<i>bkuh</i> (raphia construction)	<i>nkub-mbaah</i> (calabash)	<i>mbang-bih</i> (on the ground)
Meta'	<i>oeroer fubughe</i> (calabash)	<i>kurra bi</i> (basket lined with banana leaves)	<i>tarra muno'</i> (earthenware pot)	<i>abamunuen ge</i> (raphia construction)	<i>kurenghon</i> (basket with lid bark container)	<i>bombang</i> (on the ground)
Moghamo	<i>tikoebuek</i> (calabash)	<i>fiko</i> (basket)	<i>akwieh</i> (waxed)	<i>aba'noghi</i> (raphia)	<i>fiko-kubli</i> (basket)	<i>bo</i> (on the)

		lined with banan a leaves)	grass jug, grass pot, earthenwar e pot)	construction) <i>aba'komi</i> (wooden construction)	with lid) <i>aba-swe</i> (special round raphia fibre bag)	ground, wooden board)
Nso	<i>lahbi</i> (earthenwa re pot)	<i>nkem bii</i> (basket lined with banan a leaves)	<i>kiny melu</i> (earthenwa re pot) <i>fangom</i> (wooden pot)	<i>kikum ke rereng</i> (raphia construction)	<i>kitavke mbam</i> (calabash)	<i>mbang</i> (on the ground)
Oku	<i>keghine fenkak</i> (wood) <i>keghine teng</i> (calabash)	<i>nkem</i> (basket lined with banan a leaves)	<i>ekeng emduck</i> (earthenwa re pot)	<i>kuni leng</i> (raphia construction) <i>kuni fenkah</i> (wooden construction, for nobles)	<i>ke chak</i> (carved wooden box, bark container, calabash)	<i>shangse e</i> (on the ground, wooden board)

Source: Hans Knopfli, 2001

Table 2: The main tree species used for wood carving in Bamenda Highlands

Ecological Zone	Name	Uses and observations
Montane forest: Sample sites: 1. Oku 2. Kedjom Keku 3. Kedjomketinguh 4. Ndu	<i>Cordia platithyrsa</i> (Beraginacea)	Royal beds, thrones, stools, status, mortars
	<i>Ficus oreodryadum</i> (Moraceae)	Resistant to insects and used for mortars and stools
	<i>Polyscias fulva</i> (Araliceae)	Good light carving wood for masks, status, doorposts, house posts, door frames

	<i>Pachylobus edulis</i>	Mediocre wood used for drums and stools
	<i>Schefflera abyssinica</i> (Araliaceae)	Usable for carving
	<i>Craton macrostachyus</i> (Euphorbiaceae)	Possible carving wood.
	<i>Canthium dunlapii</i> (Rubiaceae)	Walking stick
	<i>Milletia conraui</i> (Papilionaceae)	Containers are made out of its bark
	<i>Allophyllus bullatus</i> (Sappindanceae)	Bark used for making beehives
	<i>Lasiosiphon glaucus</i> (Thymelaeaceae)	Bark used for paper – making
	<i>Fagara rubescens</i> (Rutaceae)	Xylophones made from it because it is light and produces best sound
	<i>Tabernaemontana pachysiphon</i>	Good for carving
	<i>Ranvolfia vomitoria</i>	Good for carving
	<i>Voacanga Africana</i>	Medical and good for carving
Savannah woodland: Sample sites: 1. Bali-Nyonga 2. Bafut 3. Kom 4. Meta area 5. Moghamo area	<i>Syzygium standii</i> (Myrtaceae)	Best wood for making charcoal
	<i>Cordia platithyrsa</i>	Royal beds, thrones, stools, statues and mortars
	<i>Vitex ciliate</i>	Yellowish wood good for sawn timber and for carving, mortars, stools, and talking drums.
	<i>Dacryodes edulis</i>	Used for making the talking drums
	<i>Polyscias fulva</i>	Used for making the stringed, one-headed hourglass drum

	<i>Antiaris welhitchii</i>	“sand paper leaves” and charcoal
	<i>Afzelia bipendensis</i>	A possible carving wood
Flood plain: Sample site: Babungo	<i>Cordia platithyrsa</i>	Royal beds, thrones, stools, status and mortars
	<i>Dacryodes edulis</i>	Used for making the talking drums
	<i>Funtumia elastica</i>	Wood of a mediocre quality for carving
Lowland forest: Sample sites: 1. Lower Bafut 2. Obang 3. Esimbi 4. Aghem 5. Weh	<i>Diospyros crassiflora</i> (King ebony) and <i>Diospyros suaveolens</i> (Queen ebony)	Excellent wood for sculpture. It is much used for carving small items such as walking stick, statuettes, busts, book-ends and the like. This is an extremely scarce and endangered wood which is found where anthropic influence is near absent - locally termed “black forest”

Table 2 presents the plant species used for carving. Due to the degradation of tree species almost any kind of wood is used now for carving, that is, the cheapest and the most accessible types. Good wood for carving is refuged in mountain escarpments, montane forests and topographic sites difficult for man to penetrate easily. Since the species *Cordia platithyrsa* plays such an important role in wood carving, there is the need to regenerate this species through the raising of seedlings. This is because:

- It reproduces readily;
- It regenerates naturally from seeds but cuttings also grow well;
- Its sweet ripe fruit contains gum and is a delicacy for bats, which disperse the seeds;

- Traditionally this tree is used for demarking boundaries between ethnic groups, villages, hamlets and compounds;
- Cuttings sprout even in the dry season and grow into trees in a comparatively short time; and
- When felled, the stump brings forth-new shoots within a short time.



Figure 2: Forests provide material for crafts: Mountain dweller playing a musical instrument made of wood and fibre strings while sitting on a raphia stem fabricated stool. His cap is made of fibre from the raphia palm.



Photo: Musical instrument derived from Kilum forest: Seed pod rattles encircle the ankles of tribal dancers accompanying their exultant performance with masks and xylophones. All these are products of the forests.



Photo: Sculpture mask carved from wood in Kilum. Nchinda Francis shows his sculpture – masks of animals and mythical creatures that appear in traditional ceremonies. The artist also builds houses, furniture and beehives. “If the forest is finished, we are finished,” he says.



Photo: Mat weaver using the dried leaves of *Phoenix rechinata* for weaving (Photo: J.A., Ngwa, 1979).

Large trees for wood carving are rare today. If this industry must survive, then there is an urgent need for forest development in this direction. In all the main wood carving centres, with the exception of Moghamo area, the favoured wood for carving is *Cordia platithyrsa* (Baraginaceae). It seems adaptable to many ecological niches in the highland savannah ecotone.

The bark of *Millettia conraui* is used for the manufacture of drum-like containers. These containers are indigenous to Aghem, Meta, Esimbi, Kom and Oku. Camwood (*Baphia nitida*) is a deep and red coloured hardwood which is highly treasured for its red powder used for anointing in traditional ceremonies, highly priced xylophones and sculptures. This leguminous tree is today very rare in the region. The poles of the *Raphia farinifera* are used for the fabrication of several crafts. These include; mats and baskets, ceiling boards, beds, cupboards, benches and furniture, potable animal cages and umbrellas. Fibre extracted from the fronds is used for weaving bags using a hand loom. Musical instruments are also fabricated from the raphia poles. The Indian bamboo (*Arundinaria alpina*) is found in montane zones. The

bamboo is used to produce furniture; flutes, curtain rings, and other decorative forms.

Table 3: Plant materials used for mats and baskets by various ethnic groups in Bamenda Highlands

Craft	Ethnic group	Vernacular name	Source of material (plant)	Vernacular name of plant	Plant organ used.
Gari sifter	Bali-Nyonga	sekele	<i>Arundinaria alpina</i> <i>Elaeis guineensis</i> <i>Marantaceae</i> family	bangfuch mbang ntsam	Bamboo Leaves Woody stem
Sleeping mat	Bafut Esimbi Moghamo	matta matta matta	<i>Pandanaceae</i> family <i>Pandanaceae</i> family <i>Costaceae</i> family	tekubo hete hikake fibonghi	Leaves Leaves Leaves
Floor mat	Bafut	matta	<i>Phoenix reclinata</i>	nkoung	Leaves
Ceiling mat	Bafut	nkeih- nekang	<i>Raphia farinifera</i>	netieng	Stem
Fence mat	Bali-Nyonga	nked	<i>Raphia farinifera</i>	ndom	Stem
Farm basket	Bali-Nyonga Wimbun Wimbun Wimbun Wimbun	kuka kishie kishie kishie kishie	<i>Raphia farinifera</i> <i>Heteropogon contortus</i> <i>Pennisetum purpureum</i> <i>Typha elephantina</i> <i>Malvaceae</i> <i>sida</i>	ndon fusong fusong fusong fusong	Stem Stem Stem Stem Stem
Back-pack basket	Oku	nkock	<i>Pennisetum sp.</i> <i>Malvaceae</i>	isungh ekieh ilouk	Stem Stem Stem

			<i>sida</i> <i>Raphia</i> <i>farinifera</i>		
Plaited trays	Bali-Nyonga	nkid	<i>Costaceae</i> family	muko	Stem
Bali-Nyonga basket	Bali-Nyonga	nki	<i>Raphia</i> <i>farinifera</i>	ndon	Stem
Esu-Weh basket	Esu/Weh	efu	<i>Raphia</i> <i>farinifera</i>	alleeh	Stem
Esim bi basket	Esim bi	oted	Cane / wood	schumbe	Stem
Esimbi planting basket	Esimbi	kati	Split cane <i>Elaeis</i> <i>guineensis</i>	neghueh	Stem Fronde
Esim bi granary basket	Esimbi	korombe	Cane (<i>Eremospatha</i> <i>macrocarpa</i>)	nkouh	Stem
Sewed and coiled baskets	Bali-Nyonga	kukad	<i>Imperata</i> <i>cylindrica</i> Woody herb <i>Imperata</i> <i>cylindrica</i>	kion keja (nkwala) mpun	Leaves Bark Bark
Sewed and coiled palm wine containers	Moghamo	ijoh akwieh	<i>Imperata</i> <i>cylindrica</i> <i>Imperata</i> <i>cylindrica</i> <i>Canarui</i> <i>m</i> <i>schweinfurthii</i> <i>Elaeis</i> <i>guineensis</i>	tejoah ntsam ejoah nguro	Leaves Bark Wax (resin) frond

Table 3 presents the various types of mats and baskets plaited or woven, and sewed-coiled in the area. In the areas between 300 and 1250 m above sea level the common materials for mats and gari (manioc) sifters include the oil palm fronds (*Elaeis guineensis*), indian bamboo (*Arundinaria alpina*), the

screwpine of the *Pandanaceae* family used for making sleeping mats, *Phoenix reclinata* (date palm) leaves used for making floor mats, bags and hats, and *Raphia vinifera* and *Raphia farinifera* stems used for the fabrication of ceiling mats, fence-mats, household furniture and musical instruments. The fibre from this plant is used to produce bags, hats and caps.

Various types of baskets are produced by craftsmen and women. The main source of raw materials is from the following plants: *Elaies guinensis*, *Raphia vinifera*, *Raphia farinifera*, a woody plant of the *Malvaceae* family, a woody plant of the *Costaceae* family and cane (*Iaccosperma secundiflorum*, *Eremospatha macrocapa*) in areas between 300 and 1250 m above sea level. Areas above 1250 m plait baskets from the stalks of elephant grasses such as *Heteropogon contortus*, *Pennisetum purpureum*, and type of reed (*Typha elephantina*). The top border of the basket and the hanging loop fitted to the top border are made of thread-like strips from the bark of a plant from the *Malvaceae* family. It grows in fallowed fields.

In areas above 1250 m trays and baskets are also made of grass using the sewed-coiling method. The main grass used is *Imperata cylindrica*. Two types of wrappers are used to sew the *Imperata cylindrica* coils. The reddish brown threads or veins (vascular bundles) from the pith of the extreme base part of the raphia stem is used in sub-montane areas. In montane areas the bark of a woody herb of the *Marantaceae* family (*Megaphrynium sp.*) is used. In the Moghamo area sewed coiling is also used for the fabrication of palm wine containers. In this case a resin from the *Canarium schweinfurthii* (black bush plum) is used to “wax” the inside.

These handicrafts are plaited and woven with different icons and colours using local dyes such as the red dye obtained from a shrub of the *Icacinaeae* family. The baskets have different shapes and sizes which reflect their functions. Each symbol has its meaning and specific use which reflects the social status.

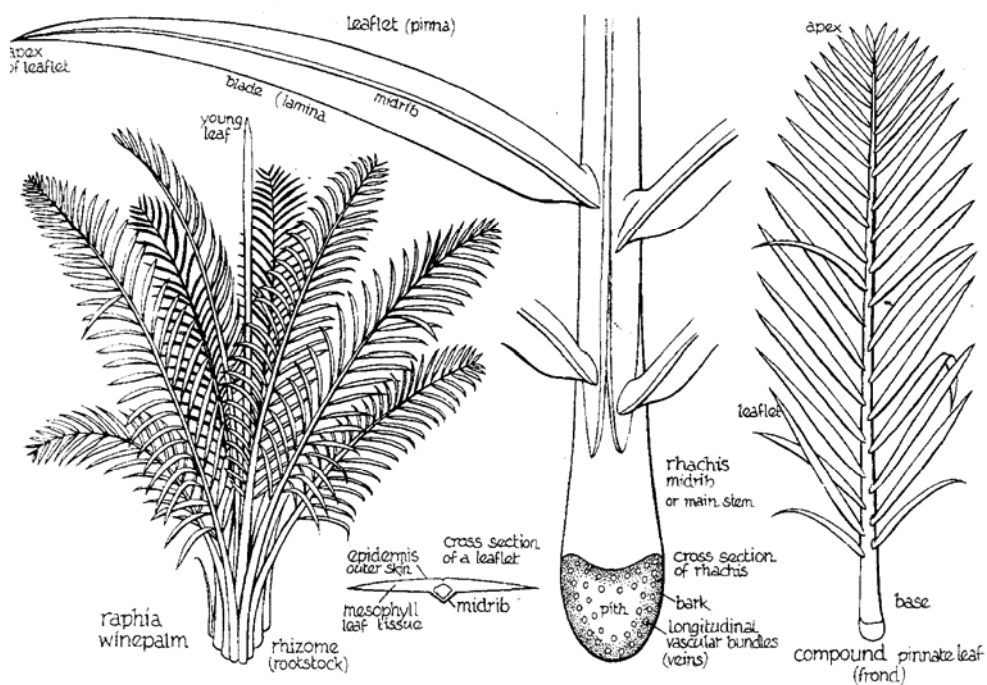


Figure 3: The structure of the raphia palm showing plant parts used for handicraft.



Photo: Weaving raphia leaves into a sheet used for the roofing of houses.

The most characteristic and widespread product of wood carving is the wooden stool or throne, decorated with symbolic figures. These icons are also found on doorposts, masks-heads, statues, houseposts, skin-covered wooden drums, wooden beds, tables, and carved door frames. Each icon has a specific meaning or interpretation. The symbols reflect an understanding of the environment, especially the nature of a large number of animals which have become extinct in the region. Thirty individual symbols constitute the iconography of the region and are found on handicrafts. These include the elephant, buffalo, leopard, lion, and python. These are considered as royal animals. Others include the scorpion (*Arachnida*), earth spider (*Heteroscodra crassipes*), deer, antelope, donkey, monkey, hare, birds (*Tauraco bannermanni*), human motif, bats, frogs, rainbow, lizard, chameleon, house spider and the tortoise among others. Inanimate icons include the double iron gong, cowry shell, bangle, spearhead, hunting net, knife-hilt and snail shell.

Conclusion

These crafts embodied the spiritual to the mundane capturing both a way of life and the artistic expression of cultural meaning for each place and ethnic group. But these crafts were more than that; they were a source of livelihood. Until recently these crafts acquired knowledge of natural materials-the properties and the sources. But the techniques of maintaining a steady supply of these materials are lacking. Habitat destruction has rendered them scarce. This specialized environmental knowledge was also part of the culture and embedded in the traditional crafts. In order to guarantee the

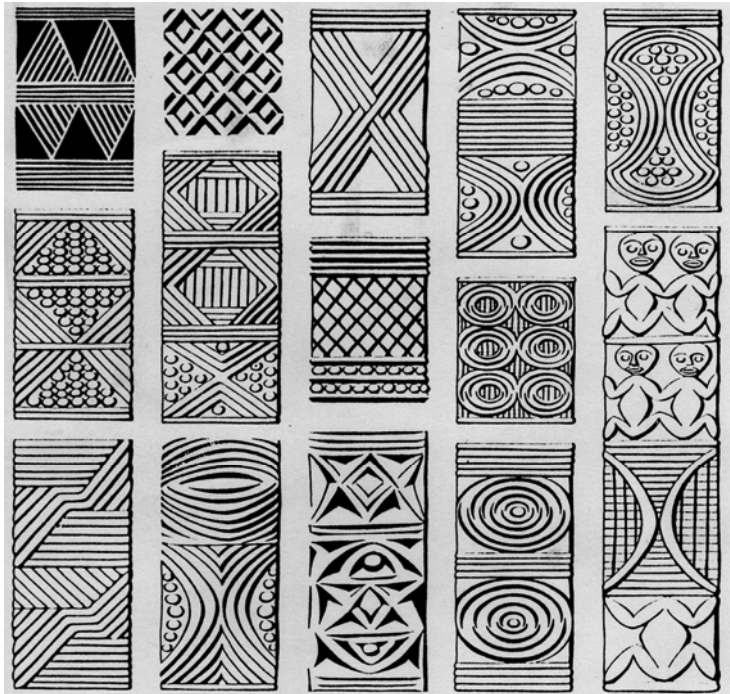
survival of this cultural heritage, there is a need to regenerate, develop and promote the tight web of natural resource input, outputs into the natural environment, economic opportunities, heritage and cultural expressions. The current rate of harvest of most of these plants resources exceeds the ability of many species to regenerate, and the harvest of a number of species can be regarded as unsustainable. Long-term monitoring should be implemented both to determine the impacts of harvesting and to aid in devising guidelines for sustainable management. There is a potential to introduce the cultivation of these plant resources in local farming systems.

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Appendix



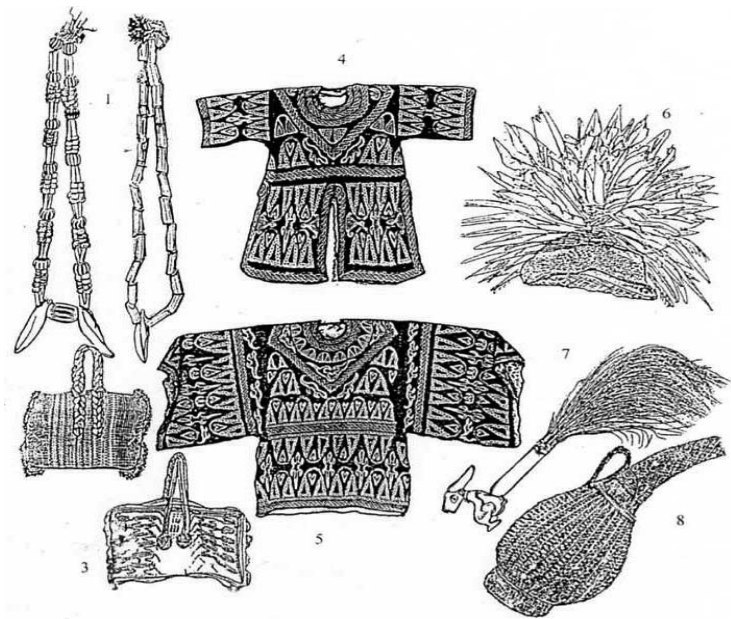
Appendix 1: Some icons carved on door posts and frames in Bamenda Highlands.



Appendix 2: Symbols and icons on handicrafts in Bamenda Highlands



Appendix 3: Stools carved with animal motifs: Good wood for carving is scarce today.



Appendix 4: Icons on some craft items in Bamenda Highlands



Appendix 5: Smoking pipes: 1, 3 & 5 = pipe bowls made of clay,
2 & 4 = pipe stones

Chapter 9

Woody Plants In Indigenous Land Use Systems of the Mandara - Diamare

Summary

The dry savannahs of Africa are fragile environments at the ante-room of desertification. The stability of this ecosystem depends on ephemeral herbs and grasses and several trees and shrubs which play a variety of roles in traditional land use systems. Despite a wealth of indigenous knowledge on their uses demographic pressure and commodification of rural products are imposing biological stress on these vital resources. The study investigates the role of trees and shrubs in the traditional land use systems of this ecosystem, the ethnobotanical uses and the indigenous knowledge base on their management for livelihoods. It uses a combination of primary and secondary data sources to establish the various indigenous uses of woody species for livelihood systems, soil and water management and indigenous agro-silvopastoral practices and concludes that there is a wealth of indigenous knowledge on the uses and functions of these resources which can be tapped and developed with experimentation. This should serve as a starting point for innovating the traditional land use systems and ensuring the sustainability of woody resources, ecosystem stability and fighting desertification. Finally, it identifies the scope for the sustainable management of vegetal resources in dry lands.

Key Words: Trees, shrubs, dry savannahs, uses and functions, degradation, management, land use systems, sustainability.

Introduction

The dry savannahs of Africa are characterized by recurrent droughts and famines, demographic pressure, overgrazing, over-cultivation and associated biological stress on the environment. The basic needs in forage and fuel wood are provided by wooded savannah and thorn bushes which unfortunately are unsustainably exploited, and are ravaged by uncontrolled fires and poor management of tree and shrub resources. Yet, the roles trees and shrubs play in traditional farming systems in general are very wide and have been described by many authors (Everist, 1972; Walker, 1980; Harmand, 1994; Beets, 1989; Brandstrom *et al.*, 1979; Boudet and Toutain, 1998). Their roles are extremely varied and depend to a large extent on the

land use practices of the people involved, population growth, traditional beliefs and values, ecology of the locality, the types of local livelihoods or indigenous uses, the level of household income and change in socio cultural habits. In the dry savannahs of North Cameroon the role of trees and shrubs has been investigated from a biogeographical and geographical perspective (Seignobos, 1982; Mahamat, 1983) and by agronomists interested in the development of agroforestry and silvopastoral management (Harmand, 1989; Peltier *et al.*; 1998; Harmand, 1994)

This chapter investigates the role of trees and shrubs in traditional farming systems, the ethnobotanical uses, the indigenous knowledge base in agro-silvopastoral management and identifies the scope for innovation.

North Cameroon is situated between latitudes $7^{\circ}30'N$ and $13^{\circ} N$ and longitudes 9° and $15^{\circ} E$. This region is semi arid in the north and sub humid in the south. Studies of the climate and hydrology of the region include those of Suchel (1982) and Olivry (1986). Recent soil studies include the work of Brabant and Gavaud (1985) and vegetation studies by Letouzey (1985). Seghieri (1990), Donfack (1993) and le Bourgeois (1993) have investigated the functioning of various ecosystems of the area.

Analysis by Donfack, Boukar and M'Biandoun (1996) confirm a spatio-temporal variability in the distribution of rainfall and high rainfall erosivity. This is a major factor determining crop yields and biomass productivity. Pedologic units broadly conform to three geomorphologic units or land systems: mountains and uplands; pediments and outwash plains or colluvial plains, and recent and old alluviums. Floristic communities are closely related to these land facets and the spatio-temporal distribution of rainfall. The northern parts of the region are sahelio-sudanian with 800 mm of rainfall per year while the southern parts are sudano-guinean with 1000 to 1300 mm of rainfall per year.

Natural plant communities in the area were studied with respect to the rainfall distribution in time, soil characteristics, the vegetation period and anthropogenic impacts. These natural plant communities are presented in figure 1. For each plant community the rainfall concentration during the wet season is as follows (Fulton *et al.*, 1974)

- Sandy open savannah: 85% of total rainfall occurs in July and August.
- Sodic zones: 75% of rainfall occurs in July, August and September
- Flood plain: 90% of rainfall occurs in the period from June to September.
- Stony loamy savannah: 85% of rainfall occurs in June to September

- Alluvial granitic sanannah: 85% of annual rainfall occurs in June to September
- Upland plateau: 85% rain occurs in June to September
- Sandy dense savannah: 80% of rain occurs in June to September
- Clayey savannah: 80% of rain occurs in July and August.

The vegetative period is very short. Consequently, the vegetation is restricted to ephemerals. These are herbs, forbs and grasses. Perennial trees must be drought resistant.

The agricultural and pastoral land use systems of the area have been studied by De Steenhuijsen (1995), Dugue *et al* (1994), Njoya *et al* (1996). The main farming systems are:

- Extensive grazing systems with transhumance
 - Crop-livestock production systems involving bush fallowing and extensive grazing
- Shifting cultivation systems in piedmont areas practised by migrant farmers from the Mandara and Mindif Mountains.

Droughts and crop failures are characteristic of the area. Overgrazing, deforestation, bush fires, soil degradation due to poor farming and grazing techniques, and associated soil erosion are causing a desertification of the region. This has necessitated the development of an indigenous knowledge base on the management of trees and shrubs which can be refined with careful scientific investigation.

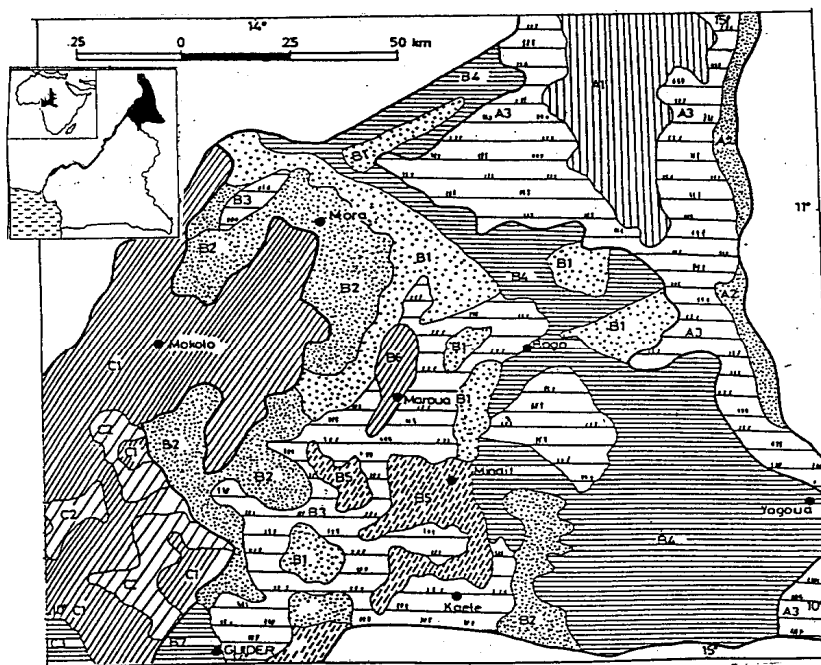
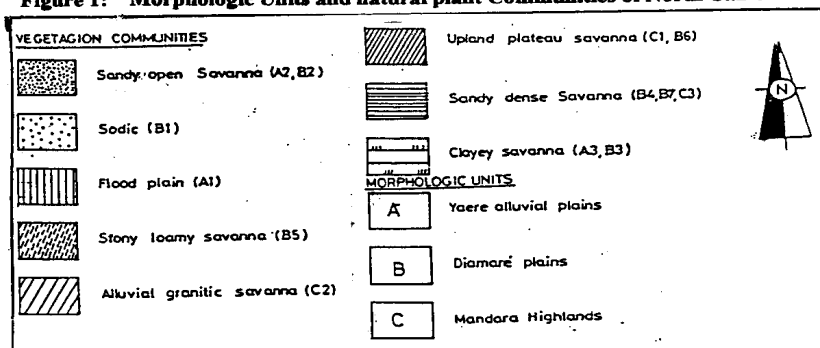


Figure 1: Morphologic Units and natural plant Communities of North Cameroon.



Source: Donfack et al. 1996; Brabant and Gavand, 1985; Brabant, 1976 and Fulton et al. 1974.

Table 1: Degree of vegetation degradation in North Cameroon (Figure 1)

Community site (land facet)	Map code (Fig 1)	Degree of degradation of the potential vegetation
Sodic	B 1	75 to 100 % of the potential plant community has been degraded and replaced by annuals
Sandy, open savannah	A 2, B2	50 to 75% of the potential plant community has been degraded and replaced by annuals or other species.
Alluvial / granitic savannah	C 2	
Clayey savannah	A 3, B3	25 to 50% of the potential plant community has been degraded and replaced by annuals and other species.
Sandy dense savannah	B 4, B 7, C 3	
Flood plain	A 1	The present plant community is almost the same as the potential plant community. Degradation has been minimal. This is because of remoteness from man

Source: Fulton *et al*, 1974

Study Methods and Data Sources

The first phase of the study involved observations and analysis of farming systems in three villages in order to identify the role of trees and shrubs in various agrosystems and the indigenous knowledge base. These were complemented by ethnobotanical surveys of farms having useful woody species, their uses and plant parts harvested by farmers. The second phase involved a study of woodlots in order to identify the most cherished species, management practices, and yields per rainfall regime and soil type. The above data were complemented by secondary data. The third phase was concerned mainly with mapping. Land use systems were mapped and updated by field observations, use of the Global Positioning System, the 1996 National Geographic Institute (Yaounde) aerial photographs, the work of Iyebe and Seignobos (1996) and Ndenecho and Lambi (1998). Monthly fuel wood consumption requirements for the main semi-urban and urban settlements were estimated and mapped based on an average monthly consumption of 2.5 m³ per household and the total number of households per settlement.

Results and Discussions

Figure 2 presents the land use systems in the study area and the monthly fuel wood consumption estimated for the main settlements. The agricultural and pastoral land use systems were investigated in the mountain and piedmont zones:

- Mountain agrosystem: In the mountain zone the Mafa tribe cultivates short cycle crops such as groundnuts, millet, sorghum and cowpeas. The system has evolved over several centuries and is characterized by terraced slopes, homegardens, outlying fields and the integration of trees and shrubs. In order to conserve soil and water by reducing runoff volume and velocity terraced slopes are stabilized with trees and shrubs. The landscape of Way-Ziver village is a patchwork of boulders, rocky slopes and granitic inselbergs, homesteads and terraced slopes with woody species (Figure 3). The main uses and functions include:

- *Phoenix reclinata* for poles and leaves for weaving of mats.
- *Pachystela brivipes* for charcoal and fuel wood
- *Croton zambezicus* pruned to encourage the initiation of floral buds (harvested and sold for local uses)
- In the talwegs there is a selection of woody species used for soil and water conservation such as *Acacia ataxacantha*, *Syzygium guinensis*, *Garcinia afzeli* and *Albizia zygia*. These are conserved in water catchments.
- *Ficus* species such as *F. dicranostyta* and *F. albutifolia* provide forage and shade, and the exudates have traditional uses.
- Fruit trees include *Vitex doniana* and *Diospyros mespiliformis*
- Trees providing poles include *Ziziphus mauritiana*, *Terminalia brownii*, *Anogeissus leiocarpus* and *Halarrhena floribunda*. These are mainly found on terrace embankments.
- Trees are rarely found on terrace shelves but for *Faidherbia albida* whose growth is well controlled.

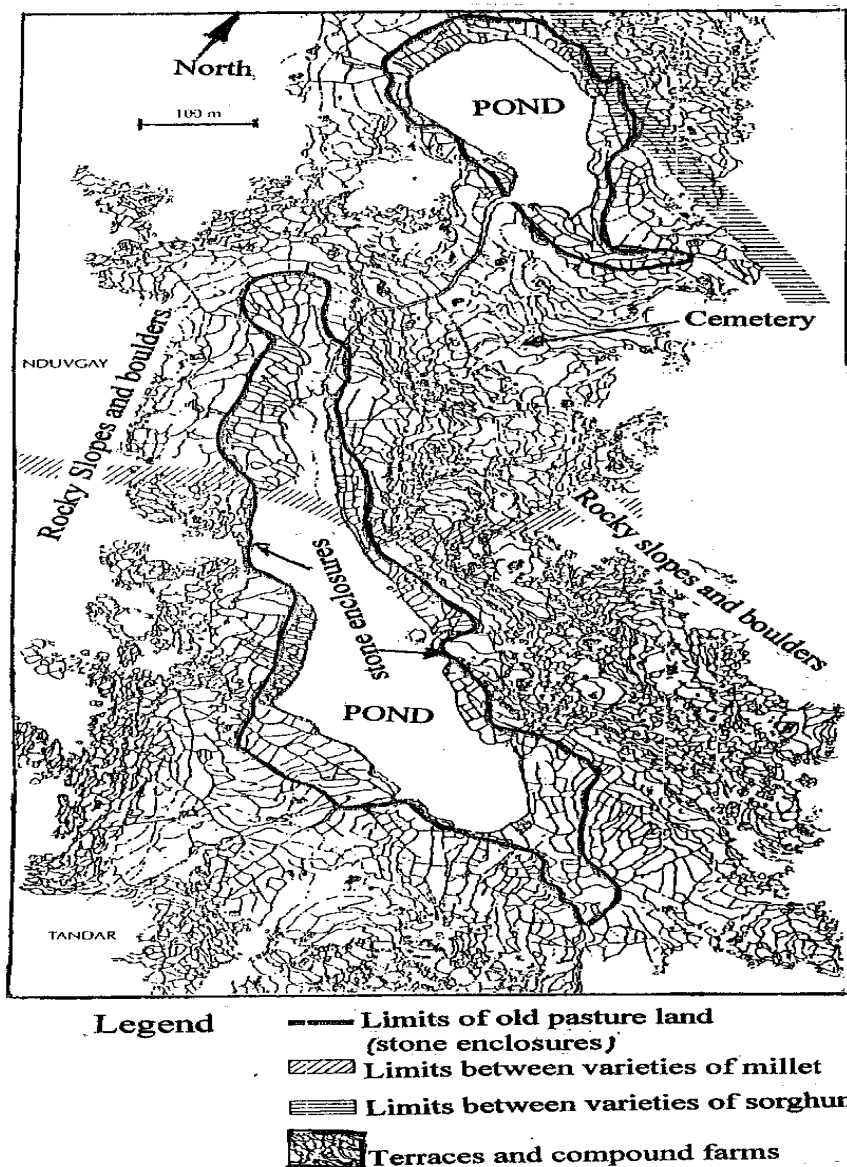


Figure 3: Mountain Land use: Terraced slopes and land use in Way – ziver

These migrant farmers from the Mandara cultivate both upland crops and other cash crops grown in the lowlands as shown in figure 4. Figure 5 on the other hand shows an extensive land use system in Wuro Labbo village established by Mafa migrants. Farm sizes range from 0,25 to 0.5 hectares. Agricultural production is more market-oriented.

The rural space in general is characterized by natural pastures composed of park savannahs, a mosaic of farmlands, fallowed fields, home gardens and

outlying fields. In the lowlands woody species are deliberately protected and managed for multiple uses. (Table 2)

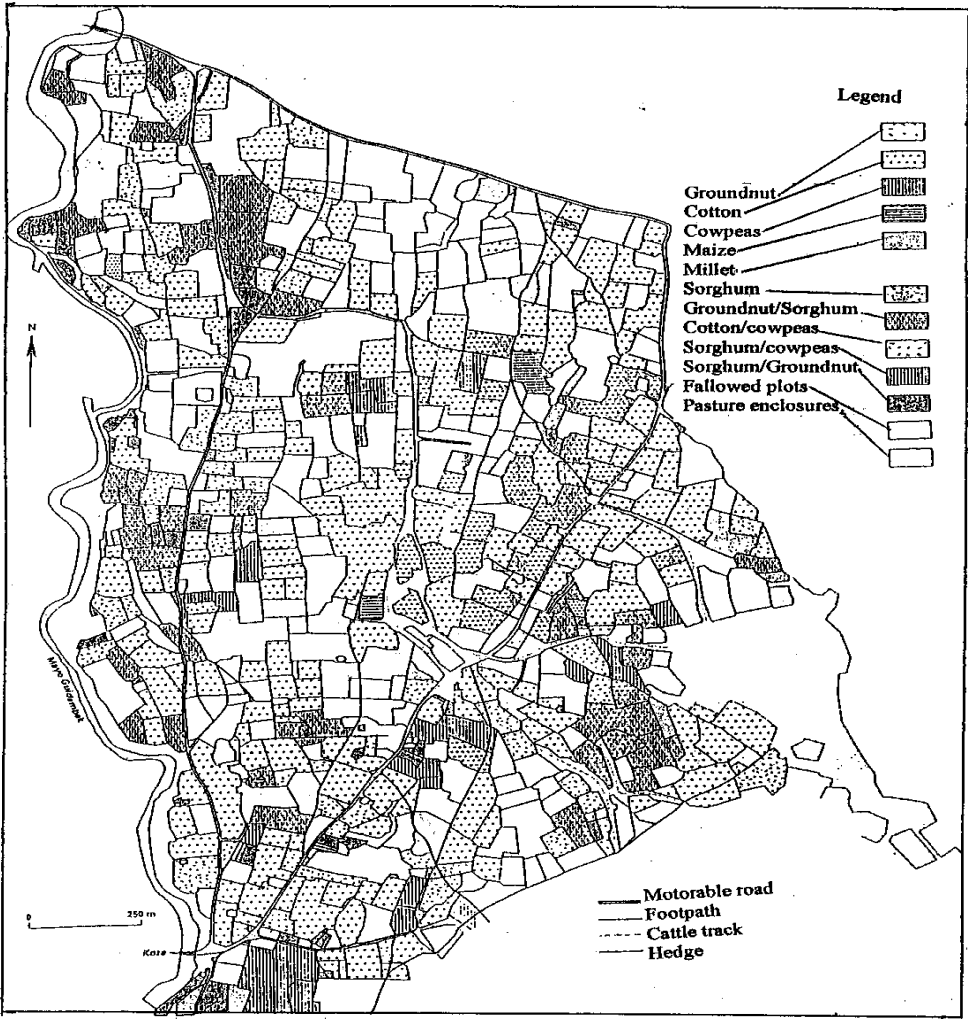


Figure 4: Land use in piedmont zone: Dakotcher village

Table 2: Some useful trees and shrubs and plant organs exploited in the Piedmont Zone

Species	Useful plant parts
<i>Acansonia digitata</i>	FP, FG, FL, GO, A
<i>Anacardium occidentale</i>	FP, FG
<i>Annona senegalensis</i>	FP, FL, F
<i>Balanites aegyptiaca</i>	FP, FG, GO
<i>Borassus aethiopum</i>	FG, GO, A, FP, FL
<i>Bosca senegalensis</i>	FP, FG, A
<i>Butyrospermum parkii</i>	FG
<i>Cadaba fannosa</i>	FP
<i>Celtis integrifolia</i>	FP, FG
<i>Hyphaxene thebaica</i>	FP, FG
<i>Mangifera indica</i>	FP, FG
<i>Moringa oleifera</i>	FP, FL, FG, A
<i>Parkia biglobosa</i>	FP, FG
<i>Phoenix dactylifera</i>	FP, FG
<i>Sterculia setigera</i>	FP, GO
<i>Strychnos spinosa</i>	FG, FG
<i>S. Innocua</i>	FP, FG
<i>Tamarindus indica</i>	FP, FL, FG
<i>Ziziphus mauritiana</i>	FP, FG
<i>Cananrium schweinfurthii</i>	FG

FP = leaves and buds, FL = flowers, FG = fruits and grain, A = roots and bark, F = fruits (pulp), G = seeds, GO = gum

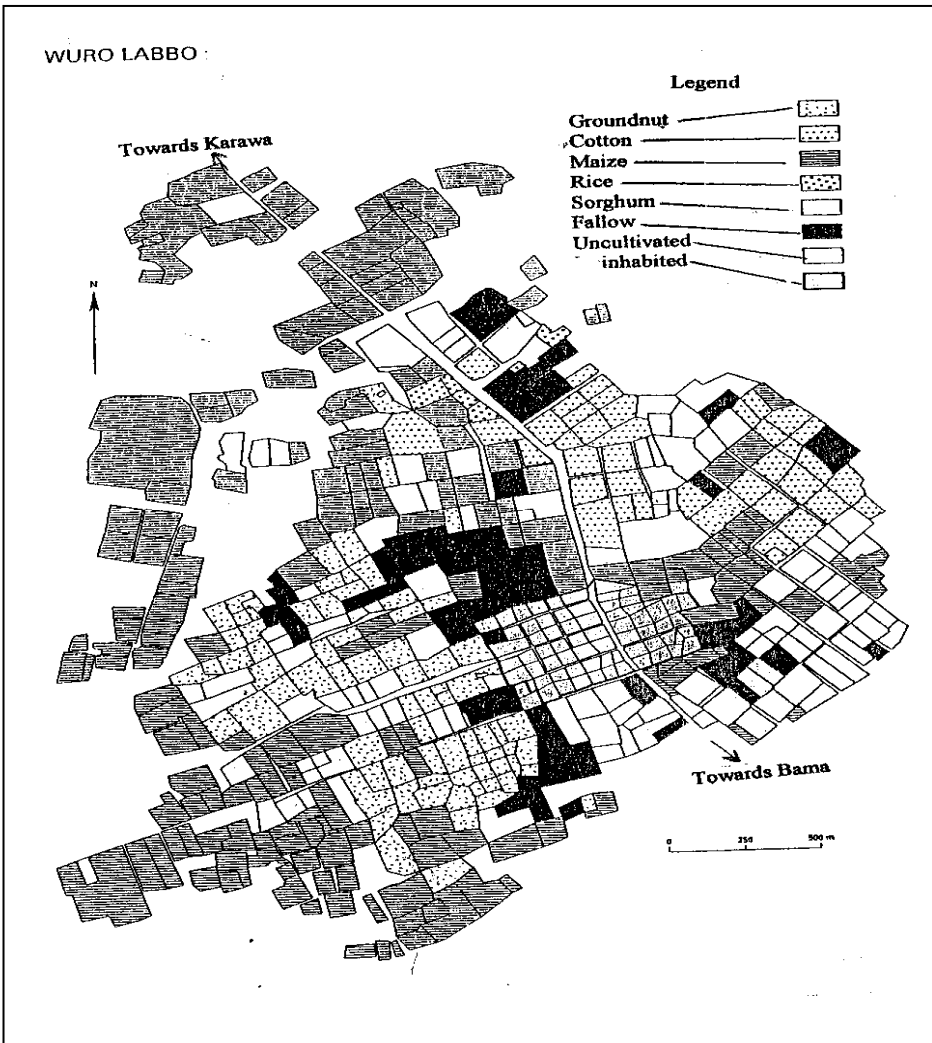


Figure 5: Land use in piedmont zone: Woro Labbo village

Table 2 presents the useful plants retained in the natural pastures and farmlands, and the plant parts or organs harvested by local people in the Diamare and Chad plains (Piedmont zone). These plants and other useful trees and shrubs are common in the park savannahs of the area. *Acacia albida* is browsed by cattle and propagated by dung. It is deliberately planted in fallows for its nitrogen fixation ability. *Borassus aethiopicum* provides food and spices, the *Ficus* are grown as a shade tree and as a browse plant. It is indicative of a landscape characterized by sedentary agriculture and little cattle husbandry. In the Mandara Mountains, *Khaya senegalensis* is grown as a shade tree, while *Acacia albida* is grown for fuel and construction wood. *Grewia* spp, *Ziziphus mauritiana* and *Terminalia brownii* are planted to stabilize

terraces on steep slopes. *Vitex doniana* and *Celtis integrifolia* provide edible fruits. *Diaspiros mespiliformies* and *Garcinia alzelic* fruits provide vegetable oils. *Strophantus spp* is planted uniquely for construction poles.

Among the Molfoudaye people, *Ficus spp*, *Anogeissus leiocarpus* and *Guierra senegalensis* are planted for agro-silvopastoral purposes. In Doukoula area *Celtis integrifolia*, *Ficus grghalocarpa*, *Tamarindus indica* and *Parkia biglobossa* are planted for agro-silvopastoral purposes unlike the Moussey area where the parks are dominated by *Prosopis Africana*, *Parkia biglobossa* and *Ficus gnaphalocarpus*. The paleo-sand dunes in the Yagoua – Limani area are agropastoral parklands. The dunes and inter-dune alkaline soils are colonized by *Acacia seyal* and *Acacia senegalensis*. These areas are used for dry season grazing of goats and cattle. Some of these trees are planted in live fences, shelterbelts, at the edge of terrace embankments, enclosures around homesteads or home gardens and night paddocks.

Table 3: Some tree species used for fuel wood and construction timber in dry savannahs of North Cameroon

Species	Fuelwood	Charcoal	Construction wood
<i>Acacia nilotica</i>	++	++	++
<i>Acacia senegalensis</i>	++	++	++
<i>Acacia seyal</i>	++	++	++
<i>Albizia lebbek</i>	+	+	+
<i>Azadirachta indica</i>	++	++	++
<i>Dalbergia sisoo</i>	++	++	++
<i>Khaya senegalensis</i>	++	++	++
<i>Prosopis juliflora</i>	++	+	+
<i>Tamarindus indica</i>	++	++	++
<i>Ziziphus mauritiana</i>	++	++	++

Key: ++ Excellent, + averagely good.

Table 3 presents the woody species exploited for wood and timber for rural and urban needs (Figure 2). With a rapid demographic growth rate of 3.6% per year (Dugue *et al*, 1996) there will continue to be biological stresses on the useful trees and shrubs. Timber, fuel wood and forage needs of the people have to be supported by the shrub and wooded savannahs which unfortunately are being degraded by uncontrolled bush fires and overgrazing.

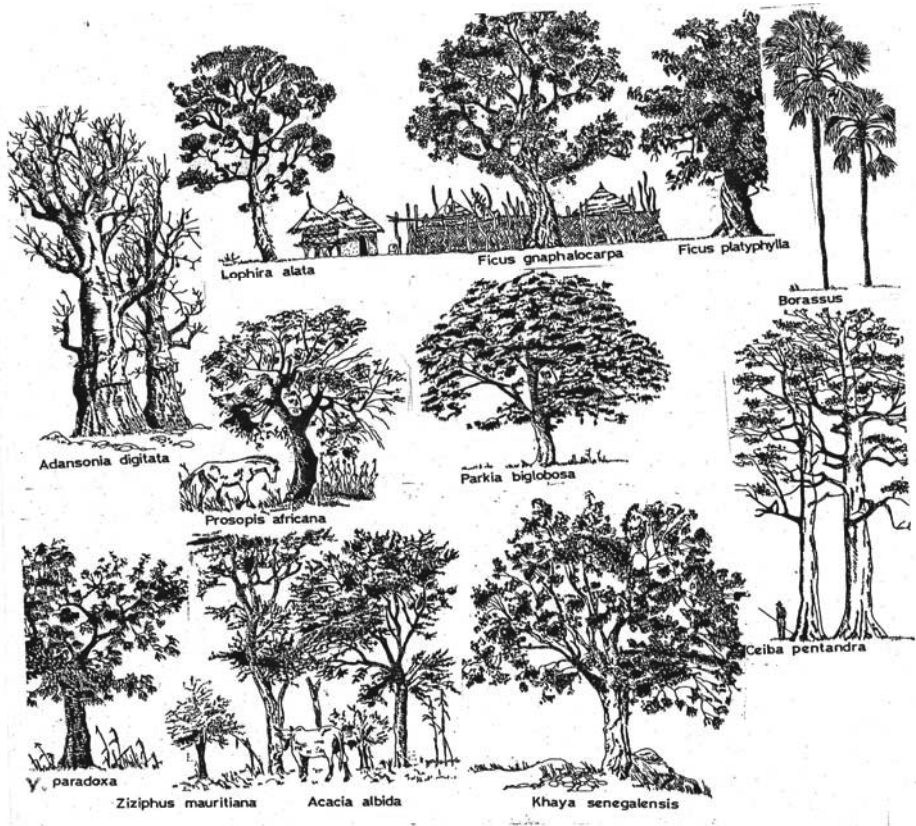


Figure 6: Some trees in the Mandara – Diamare area.

The silvopastoral management of the savannah is a concern to development workers. Peltier and Eyong (1989) demonstrated that protection against bush fire is necessary for the regeneration of forage in degraded areas and that protection against invasion by cattle, goats and sheep facilitates recolonisation and regeneration of natural pastures. There is also the need to protect the invasion of farmlands by cattle (Ntoupka, 1994; Harmand *et al*, 1992). The following plant species are planted for live hedges:

- *Jatropha curcas*: direct seeding at the onset of the rainy season.
- *Jatropha curcas* and *Commiphora africana*: planted by cuttings at the end of the dry season (March)
- *Ipomea fistulosa*: planted at the middle of the rainy season (July, August)
- Sisal: planted at the beginning of the rainy season (June, July).

Farmers prefer these species because of their rapid growth despite some management problems:

- *Ipomea fistulosa* and sisal often invade nearby farms
- *Jatropha curcas* and *Commiphora africana* produce very porous hedges that cannot prevent trespassing by animals.

In order to overcome these problems some farmers have adopted thorny woody species for live hedges. These include *Accacia nilotica* and *Bauhinia rufescens*. These are pruned to a height of 0.8 to 12 m.

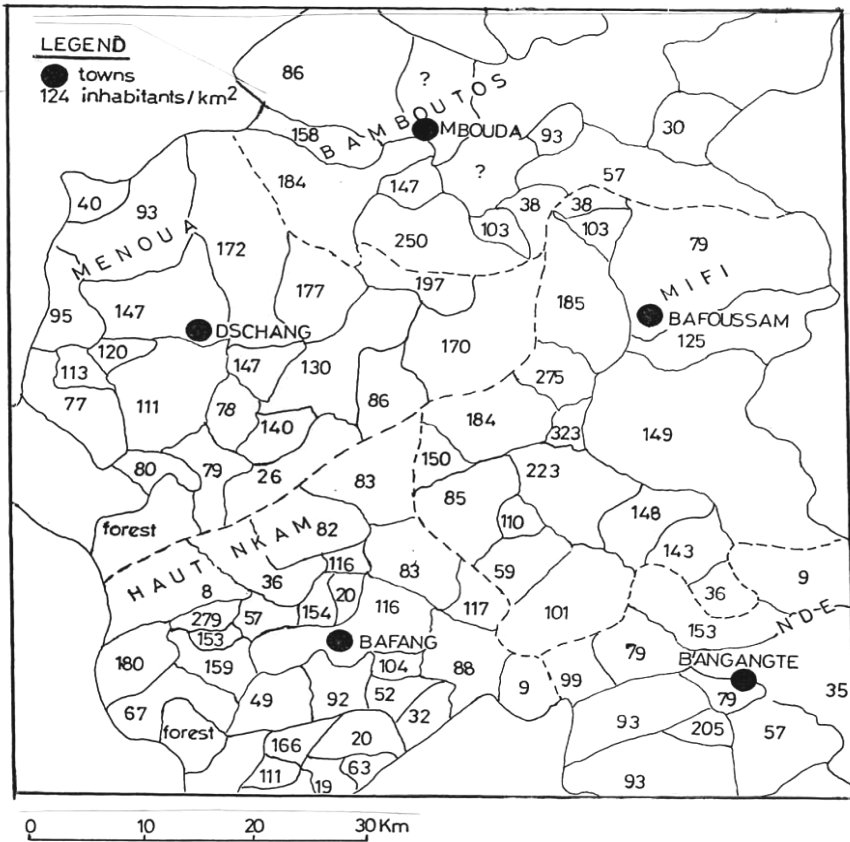


Figure 1: Rural population density in Bamileke Plateau, Cameroon (modified after Champand, 1973)

Acacia hockii, *dichrostachis glomerata* and *Piliostigma reticulata* are fire tolerant and can withstand intense browsing. These trees therefore proliferate where the incidence of bush fires is low and constitute important fuel wood resources. Trees with a girth of about 12 cm are capable of reconstituting

their biomass in 3 to 4 years. The frequency of wood harvesting can be controlled and reduced below 4 years in order to avoid its rapid invasion and recolonisation of natural pastures. On the contrary *Anogeissus leiocarpus* has a very slow rate of regeneration requiring that harvesting be delayed (over 6 years) in order to guarantee sustainability. It also needs to be protected against bush fires in order to enhance natural regeneration by seeds.

There is a general decline in the production of wood in the area due to very short harvesting rounds of 3 to 4 year durations. In the short – term such intense exploitation depletes the savannah of its woody species. This further complicates the problem of managing the savannah for fuelwood production, browse availability and pastures free from invasion by undesirable trees. It was observed that natural pastures with limited incidences of bush fires were rapidly recolonised by woody species and the grasses shaded out. Some management lessons can be drawn from these scenarios as development paths:

- The management of dry savannahs by associating wood production with pasture improvement programmes.
- The protection of natural vegetation communities against dry season bush fires and the promotion of wet season grazing and browsing should permit the regeneration of woody species, ephemeral herbs and grasses. Selective harvesting of wood can then take place after 5 to 6 years.
- Tree felling at a height of 2 metres from the ground surface can protect the wound of the stump from fire attack as well as coppicing from browsers and therefore ensuring regeneration. This method is practiced by farmers in felling species such as *Anogeissus leiocarpus*, *Balanites aegyptiaca*, *Tamarindus indica* and *Acacia spp.* on farmlands.
- Frequently browsed species should be conserved and their integration in crop, crop-livestock and livestock production systems encouraged.

The above agro-silvopastoral management model seeks to develop a stratum of woody species for wood production and for dry season browsing above a grass/herb strata used as natural pastures (Boudet and Toutain 1980).

Table 4: Exotic and indigenous trees planted in woodlands in the North Cameroon Savannas

Species	Origin	Soil type	Rainfall (mm/yr)	Wood yield (m ³ /ha./yr)
<i>Eucalyptus camadulensis</i>	Exotic	Vertisols	800	1.5-2.5
		Planosols	800	1.0
		Sandy and	500	0.3
		Ferruginous	1000	0.9
		Sandy and	1000	2.5-3.5
		Ferruginous	1000	3.5
		Sandy and Ferruginous soils		
<i>Dalbergia sissoo</i>	Exotic	Vertisols	800	3.5
		Planosols	800	0.55
		Lithosols and	800	1.0-30.
		Vertisols		
<i>Azadirachta indica</i>	Exotic	Planosols	800	2.0
		Ferruginous	800	0.1
		soils	800	1.0-2.0
		Vertisols		
<i>Leucaena leucocephala</i>	Exotic	Ferruginous soils	1000	0.1
<i>Acacia seyal</i>	Local	Vertisols	800	3.2
<i>Acacia polyacantha</i>	Local	Ferruginous	1000	3.0
<i>Acacia senegalensis</i>	Local	soils	800	1.4
<i>Acacia hockii</i>	Local	Vertisols	800	1.5
<i>Acacia nilotica</i>	Local	Vertisols	800	1.6
<i>Anogeissus</i>	Local	Vertisols	800	1.0
<i>leiocarpus</i>		Vertisols		

Source: Peltier, 1988; Harmand, 1989; Harmand *et al.* 1992; Brugiere *et al.* 1994.

Table 4 presents the results of multipurpose tree trials carried out on various soils and rainfall regimes in the study area. The results have yielded a variety of multipurpose trees (fuel wood, construction wood). *Eucalyptus camaldulensis* was imported from Australia. Apart from wood production the leaves constitute good quality browses. *Azadirachta indica* (native of India) is

used for extensive reforestation. It is regenerated by seeds and farmers use it as a shade plants, for fuel wood plantations and woodlots, the leaves are an insecticide and are also medicinal. Local *Acacia* species are nitrogen fixing and therefore are planted in fallows for soil enrichment, and the provision of fuel wood. *Acacia senegalensis* has a medicinal exudate used in the food and perfume industry. *Acacia polyacantha* produces an exudate with similar uses. *Acacia nilotica* is mainly used for hedgerows. *Ziziphus mauritiana* is a shade tree on most soils. In Mandara Mountains it is used to stabilize farm terraces (Fenyo, 1994). *Parkia biglobosa* provides edible fruits and is grown in woodlots on ferruginous soils, sandy soils and alluvial soils. *Borassus aethiopium* grows slowly. Useful parts include leaves, fruits and wood. Its propagation is encouraged on alluvial soils, sandy and ferruginous soils. Propagation is by direct seeding (Harmand *et al.* 1996).

Densely populated rural settlements in the area provide a good opportunity for the development of village woodlots and fuel plantations. Unfortunately, development efforts in this direction have not been fruitful. This is because farmers have their preferential choices of useful multi-purpose trees.(Harmand, 1994; Damou, 1995). However, individual plantations are being realized with the introduction of the “tuangya” system and *Eucalyptus camaldulensis*.

Table 5: Plant species encouraged by rural development agencies for hedgerows and live fences in North Cameroon.

Species	Method of propagation			
	Cuttings	Layering	Suckers	seeds
<i>Acacia ataxacantha</i>	*		*	*
<i>A. senegal</i>				*
<i>A. seyal</i>			*	*
<i>A. sieberiana</i>			*	*
<i>A. pylacantha</i>	*		*	*
<i>Adenium obesum</i>	*		*	*
<i>Albizzia adiantifolia</i>	*			*
<i>A. glaberima</i>	*			*
<i>A. lebbeck</i>	*		*	*
<i>Anacardium occidentale</i>	*	*		*
<i>Anogeissus leiocarpus</i>				*
<i>Balamites aegyptiaca</i>				*
<i>Bauhinia refescens</i>				*

<i>Boswellia dalzielii</i>		*	*	*
<i>Carnarium schweinfurtii</i>				*
<i>Cassia siamea</i>			*	*
<i>C. singueana</i>			*	*
<i>Casuarinas equisotifolia</i>			*	*
<i>Combretum aculeatum</i>	*		*	*
<i>Commiphorra aculeatum</i>	*		*	*
<i>Commiphorra kerstingii</i>			*	*
<i>Cyperus esculentus</i>			*	*
<i>Dichrostachys glomerata</i>	*	*		*
<i>Dracaena arborea</i>			*	*
<i>Eleusine coracana</i>			*	*
<i>Eucalyptus spp.</i>			*	*
<i>Euphorbia desmondi</i>	*		*	*
<i>E. kamerunica</i>	*		*	*
<i>E. unispina</i>	*		*	*
<i>Erythrina spp.</i>	*		*	*
<i>Ficus spp.</i>	*		*	
<i>Grevilles robusta</i>			*	*
<i>Harungana madagascariensis</i>	*		*	
<i>Hibiscus sabdariffa</i>	*		*	
<i>Ipomea Sp.</i>	*		*	
<i>Jatropha curcas</i>	*		*	
<i>J. gossypifolia</i>	*		*	
<i>Khaya senegalensis</i>				*
<i>Moringa oleifera</i>	*			*
<i>Parkin biglobosa</i>		*	*	
<i>Podocarpus mannii</i>			*	*
<i>P. milanjanus</i>			*	*
<i>Polyscias fulva</i>			*	
<i>Spathodea campanulata</i>				
<i>Ziziphus spp.</i>	*	*		*

Table 5 presents tree species used as live fences or hedges. The region is also characterized by a harsh climate and strong winds. On farmland and natural pastures most of the species have been degraded and are mostly refuged in live fences and hedges around homesteads. Most of them are propagated by seeds. Wind and water are therefore, important natural agents of propagation. Unfortunately, the browsing of young trees by cattle, sheep, goats and horses hinders growth. Seasonal fires in the area destroy most young seedlings. In live fences and hedges these are planted either by suckers or cuttings.

Conclusion

Trees and shrubs will for a long time continue to play a vital role in traditional farm families in the region, and despite the neglect in incorporating them into both crops and pastoral production systems for proper management. Some conclusions can be formulated:

- Trees and shrubs have a great potential for improving productivity of the major production systems (range and crop lands)
- The region is equipped with forage suitable agro-forestry and browse plants that require appropriate management to enhance crop-livestock production.
- Browse species are sufficiently rich in their crude protein contents as to maintain animals in the dry season (Peltier and Eyong, 1989).
- Many multipurpose trees and shrubs could be found in all the ecological niches and could be an incentive for both agro-forestry and ruminant production.
- There is a great need for controlled grazing and increased fodder production.

With increasing demographic pressure in the region these resources are rapidly being degraded. There is need to reconstitute, innovate and protect the indigenous wooded savannah. Research and development actions should focus on the agro-silvopastoral management of the wooded savannahs, studies on ecosystem functions and the flow of nutrients (materials) and energy, and on improvement of fallows with multipurpose woody species.

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Chapter 10

Indigenous Trees and Shrubs in Home Gardens of Bamileke Plateau

Summary

Man in his agrarian civilization developed site-specific farming systems that were at equilibrium with local culture, socio-economic circumstances, and ecology. Production was oriented mainly to farm family subsistence. Due to rapid demographic growth, access to markets and the influence of foreign values, these once sustainable agroecosystems are foundering. This chapter investigates the structure, composition, and interactions of the compound farm system or home garden with local culture and ecology using a combination of field observations, ethnobotanical surveys, informal interviews and secondary data. It identifies the strengths and weaknesses of the system, the main threats to its sustainability and concludes that the compound farm is a gene bank for potentially useful but endangered plant species. The concept of the compound farm system as multipurpose gene banks requiring little inputs but enjoying protection by farmers who derive benefits from the system, may be the only way to minimize the current genetic erosion occurring in tropical montane forest ecoregions. The chapter therefore recommends that agroforestry research programmes must emphasize the production of seedlings of these multipurpose species in the short-term. In the long-term, exploitation of variations in phenology both within and between species could result in longer term or all year round availability of desired vegetables, fruits, and other useful organs. There is need to enhance the productivity and sustainability of the compound farm system as a possible niche for the preservation of useful plant species.

Key Words: Compound farm, ecological stability, ecological functions, degradation, gene bank, sustainability.

Introduction

A closer look at the situation of tropical agriculture reveals that change has taken some paths. Originally, agriculture depended on local natural resources, knowledge, skills and institutions. Diverse site-specific farming systems evolved out of a long process of trial and error in which balances were found between the human society and its resource base. In most cases, production was oriented mainly to the subsistence of the family and the

community (Reijntjes *et al*, 1995). Traditional farming systems continued to develop in a constant interaction with local culture and ecology. As conditions for farming changed, for example, because of demographic growth or the influence of foreign values, the farming system was also changed (Kappelle *et al*, 2000). Many traditional farming systems were sustainable for centuries (TAC/CGIAR, 1988). Mountain cultures and ecosystems face three primary threats: Land scarcity fuelled by inequitable ownership patterns and control of public resources, intensive resource extraction, and mass tourism and recreation. However, these systems have had to cope with rapid changes since the colonial period: the introduction of foreign education and technology in agriculture and health care; increased population pressure; changes in social and political relations; and incorporation into an externally controlled international market system. The compound farms of the tropics need adjustments to these changes (Nair *et al*, 1986). This chapter investigates the structure, composition and functions of the compound farm as a gene bank for potentially useful but endangered species, and identifies the scope for tapping and keeping alive this valuable indigenous knowledge about genetic resource management.

The Bamileke plateau is located in the West Cameroon Highlands which are an ample rainfall area in the Sudano-Guinean Savanna ecological zone. The highlands are horst-like mountains mostly with an altitude of 1500m above sea level. This is a region of plateaus of varying heights with lava accumulations forming the main mountains. Two main relief features are typical:

- There are basalt i.e. plateaus formed by the flows of basalt in Dschang (Foukoue), Mbounda, Bandjoun and Bazou. The study focuses on this area.

- Mount Bambouto which is a mountain block at the centre of these plateaux is greatly dissected by erosion and has an elevation of 2740m. There are many trachytic outcrops near the summit. The succession of volcanic stages seems to be ignimbrite-basalt-trachyte and phonolite (Tchoua, 1979).

The soils are Ultosols derived from basalts and trachytes with varying degrees of weathering. Precisely, the soils are acidic, low in major nutrients and have high phosphorus requirements. Due to population pressure, food crop fields are found on steep slopes where erosion losses are phenomenal leading to a decline in soil fertility. Using purchased inputs to overcome the above degradation scenarios in the traditional farming setting appears remote because farmers lack adequate cash and good input delivery networks.

The characteristics of the present vegetation landscape have formed under the influence of intense human activity (Letouzey 1968). See figure 1 for the population density. Letouzey, (1979) classifies the vegetation landscape as a “sub-montane domestic landscape derived from moist montane evergreen forest”. Tamura (1986) demonstrates that agriculture on the plateau had been widespread for nearly 2000 years B. P. This resulted in widespread deforestation inducing soil erosion which is recorded in truncated regolith profiles, and the presence of artifacts in the migratory layers of profiles. The above considerations lead to the conclusion that forest had been considerably degraded by human activities by 2000 years B. P. Montane – related farming systems have therefore developed over the millennia as a result of interactions between high demographic pressure and the available natural resource base (Ngwa, 2001; Ndenecho, 2005).

Compound farms are a traditional land use system that appears to have evolved from the shifting cultivation and bush fallow systems as a result of high population pressure and the need to establish individual land tenure. The system has been recognized as a potentially sustainable land use (Lagemann, 1977; Fernandes and Oktingali, 1984). It has possible application for the whole of the humid tropics. Figure 2 presents the possible nutrient cycles at the compound farm level. It presents the possible losses of nutrients, and natural gains of nutrients and management options. Within the farm level, nutrient flow is more or less cyclic. This guarantees the sustainability of the system because it seeks to optimize nutrient availability and cycling (Reijntjes *et al*, 1995). This once ecologically stable farming system which constitutes the last remnant of potentially valuable germplasm banks of traditionally important multi-purpose trees/shrubs of the montane and sub-montane tropical regions is threatened by rapidly changing socio-economic conditions resulting from land use pressure and increasing access to markets (Fernandes and Nair, 1986; Okafor, 1981; Okafor, 1982; Nair and Streedham, 1986).

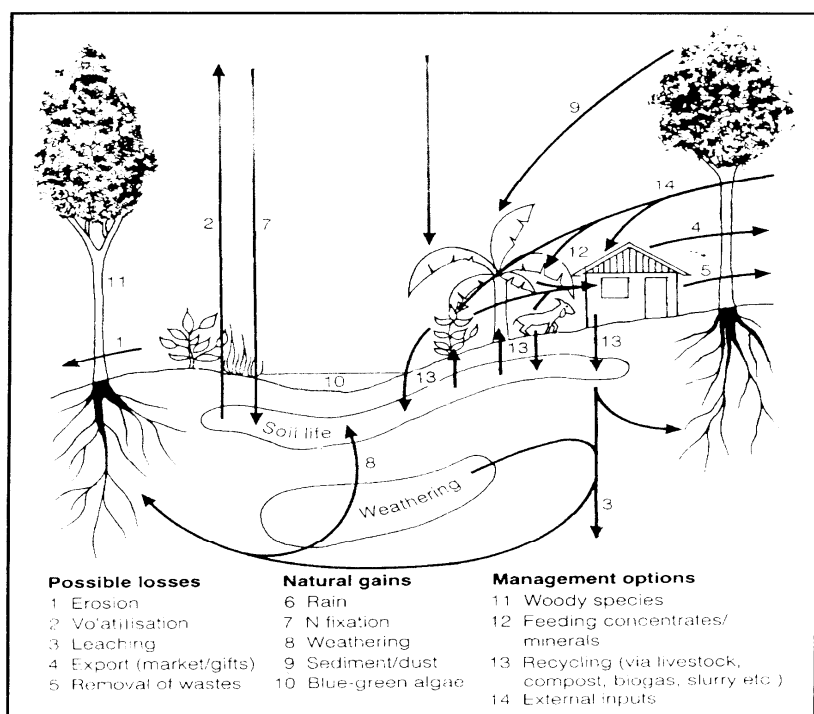


Figure 2: Model of nutrient cycle at the compound farm level (after Reijntjes, *et al*, 1995, p. 66)

Methods and Data Sources

Based on the interpretation of aerial photographs covering Bamendjou, Penka-Michel, Bandjoun and the Koung-khi areas, the structure and functioning of compound farms were investigated. The compound farm landscape was mapped in the Bamendjou area (Figures 3 and 4). A total of 244 compound farms were randomly selected in 7 villages for study. These were investigated in terms of the structure, functions and composition of compound farm components, management options and the major threats to the agroecosystem. A combination of field observations and informal interviews were employed. Floristic components of the system were identified and recorded together with the indigenous uses and functions indicated by each farm family head. The data obtained were complemented using secondary sources. The data so obtained assisted in the establishment of the ecological significance of the agroecosystem, the threats to the system and the scope for innovation.



Photo: Aerial photograph of the Bamendjou – Balessing area showing compound farms and the distribution of gallery swamp forests (IGN photo NB – 32 – X1 – 1C 200).

Results and Discussions

Figure 3 presents a compound farm landscape in Bamendjou. Compound farms are found within the vicinity of homesteads and comprise numerous multipurpose woody species in intimate multistoried associations with annual crops and small livestock. The multistoried structure and species diversity allow almost complete coverage of the soil by plant canopies thereby promoting soil conservation (Beets, 1989; Asah, 1994; Okafor, 1981; Fernandes, 1984). The compound farm plots are enclosed by live hedges. Soil fertility is maintained by the use of household refuse, crop residues, animal manure, and thatching grass (*Hyparrhenia spp.*) from renewed house roofs after every 4 to 5 years.

It is a perennial cropping system involving rain-fed production. The average farm size is estimated at 1.2 hectares. Land tenure is by inheritance. The system is characterized by the perennial cropping of Arabica coffee, with over 95% of the plots intercropped with food crops. Bananas and plantains

dominate, followed by maize, beans, cocoyams, colocassia, sweet potatoes and cassava. Root crops are markedly abundant. Fruit trees and other multipurpose trees are randomly scattered on the field and also are a main feature of the live fences. These provide shade and have other economic uses. The live fences constitute farm plot boundaries. The farm developmental stages are as follows: about 3 years to first crop, about 7 years to full bearing of coffee, which can continue up to 20 to 25 years. Trees are perennial and intercropping with annual food crops is typical. Replanting is done of individual bushes, parts of plots or whole plots when bushes die or show an important drop in yield (Tissandier, 1979). Crops are planted on mounds and ridges. Farmers bury and burn vegetation and crop residues (the Ankara method) to temporarily restore soil fertility on food crop plots making sure that perennial crops and useful trees/shrubs are not killed.

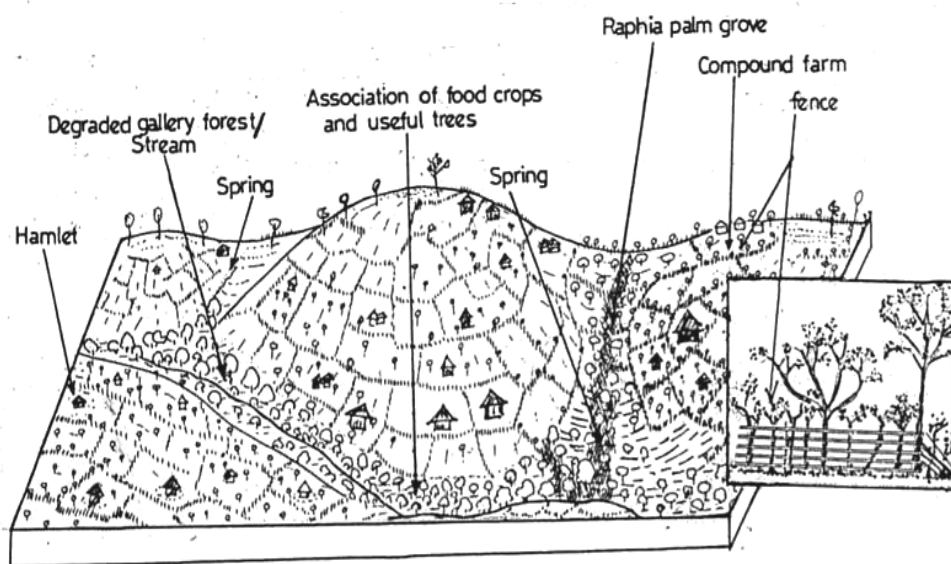


Figure 3: Compound farm landscape and the structure of the live fence in Bamileke plateau, Cameroon.

Table 1: Soil Fertilization Practices in the Bamileke Plateau

Crop association	Percentage of farmers (%) out of a sample of 244							
	Organic manure		Inorganic fertilizers		Inorganic and organic manure		No manure + no inorganic fertilizer	
Coffee crop only	1	0.4	69	28.2	69	28.2	105	43.0
Mixed food crop/coffee	14	5.7	56	22.9	127	52.0	47	19.2
Food crops only	21	8.6	42	17.2	149	61.0	32	13.1
Subsistence crops only	51	20.9	10	4.0	27	11.0	156	63.9

The study investigated the soil fertility management practices in the system. Table 1 presents the adoption of practices by farmers. Inorganic fertilizers is used mainly for the coffee crop (28.2% of farmers) although it may also benefit food crops (17.2% of the farmers). The combination of organic, inorganic and organic fertilizers (manure) is adopted by 61% of the farmers on food crops fields. On the whole, 43.0% of the farms depend on natural soil regeneration for the coffee crop only, 19.2% for mixed food crop and coffee crop, 13% for food crops only and 63.9% of the farmers for subsistence crops only. Inorganic fertilizers are therefore used mainly for cash crops. It is therefore no longer a low external input agricultural system depending mainly on natural nutrient recycling through the association of useful trees and crops. Thatching grass for house roofing has rapidly been replaced by corrugated iron sheets. Compound farms cannot therefore be occasionally mulched with worn out thatching grass from roofs.

The land use system and structure of the compound farm is presented in figure 4. The dominant staple crops include cocoyam (*Xanthosoma sagittifolium*), *Colocasia esculenta*, *Dioscorea sp*, bananas (*Musa spp.*), plantains (*Musa paradisiacal*), and maize (*Zea mays*). These are usually grown in mixtures with some subsidiary crops such as Okra (*Hibiscus esculentus*), pumpkins (*Cucurbita pepo*), melon (*Cococyyntis vulgaris*) and leafy vegetables. Sweet potatoes are an important cover crop. Cassava (*Manihot utilisissima*) is a locally important crop. Fruit trees include mangoes, pears, paw-paw, oranges guavas plums, *Canarium sp.* and raphia palms.

Several trees and shrubs are deliberately planted and managed on the compound farms for a variety of products or function: These include the following:

- Compound farm products: food, timber, firewood, fodder, medicinal plants, manure, honey.
- Compound farm services: erosion control, soil conservation, shade provision, windbreaks, live fences against trespassers, crop protection against small ruminants.
- Soil amelioration: leaf litter serves as green manure, organic matter ameliorates soil structure and water infiltration rate. Nutrient recycling is facilitated by the multistoried association of plants.

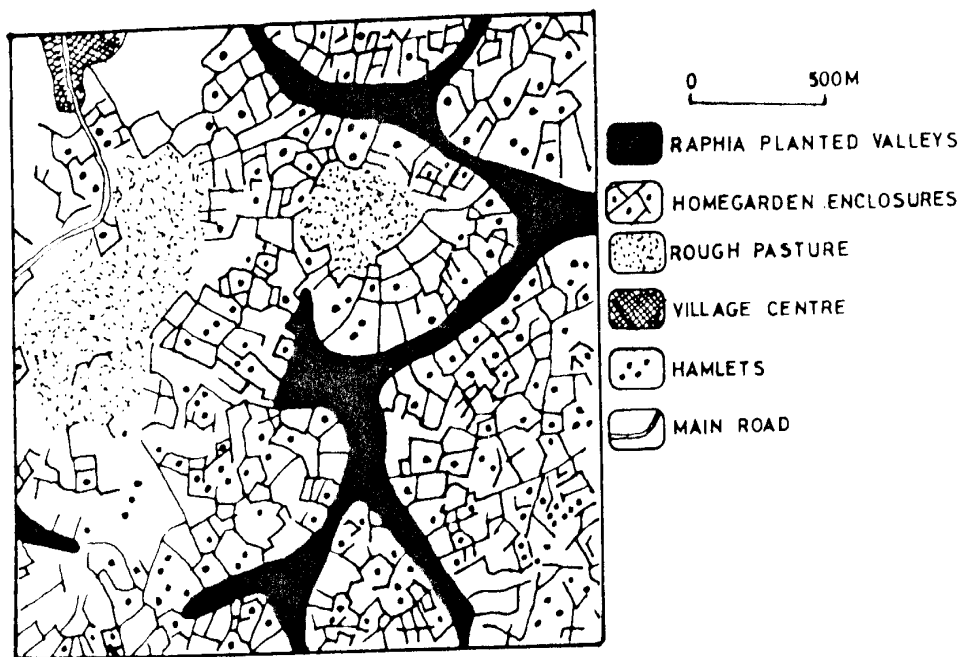


Figure 4: Live fences enclosing compound farms in Bamendjou (Bamileke plateau), Cameroon.

The landscape is characterized by a very intensive agriculture, with trees and shrubs fully integrated into the traditional arrangement of plants. The fences or hedge rows are composed of:

- Cuttings of fast growing trees and shrubs that are planted 0.8m to 1.5m apart. They serve as posts and later, some will grow to large trees;
- Other smaller plants to fill the spaces: 20 to 40cm apart; and
- An ordinary dead fence of raffia bamboo (*Raphia vinifera*)

The maintenance of the fence is done during periods when routine farm activities are less demanding in labour. It involves the following operations:

- Dead cuttings are removed and used as firewood and replaced by fresh ones at the beginning of the rainy season;
- Pruning of trees, except fruit trees and precious timber, higher than 1.5 to 2.0m, branches are used for fuel wood, leaves for green manure; and
- Routine maintenance and repair of the raffia bamboo fence.

The land use pattern varies with the soil catena. The following land use patterns can be identified: (Figure 4):

- The hedgerows make a network of foot paths in between them. These paths allow sheep and goats to have access to natural pastures on the summit without encroaching on crop fields. However, with increasing demographic pressure, these rough pastures on marginal lands are now being converted to farm plots, and house holdings.

- The homesteads are located on the middle slopes. The average farm is less than 1.2 hectares. Less than 0.5 hectares is planted only with food crops. About 0.7 hectares are planted with food crops in association with coffee; and

- The valleys are planted with raffia palms and woodlots. These gallery swamp forest are now being drained for vegetable cultivation. The techniques used by farmers are different from conventional forestry. The farmers plant the trees in croplands and continue to cultivate around them until they form a closed woodlot. Many woodlots however appear to have been established to produce poles and timber rather than firewood. However, woodlots have the following functions:

- Products: food crops, timber, poles, fuel wood, fodder, litter, melliferous trees for bees, medicinal plants.
- Services: Soil stabilization, watershed protection and insect control, shelterbelts.

Trees and Shrubs are essential perennial components of the compound farms. The potential of multipurpose trees and shrubs has been used by farmers to enhance sustainable crop-livestock production systems for centuries. Crop and range lands form a mosaic of fallow plots, cultivated fields and open savanna with trees and shrubs as a regular feature. In these circumstances where there is a marked stratification of temperature with altitude, multipurpose tree and shrub germplasm is extremely varied and

reflects current management. The main ecological niches in the compound farm systems where trees and shrubs are integrated are:

- **Crop-based production system:** Croplands, fallow lands, compound farms, coffee plantations, compound hedges and boundary fences. The main vegetation types are: Legumes and shade trees, fruit trees, browses and live fences. Goats and sheep are main animal components.

- **Mixed crop-livestock production system:** Farmlands, natural pastures, fallow lands, contour bunds, boundary fences, coffee plantations, compound farms. The main plant components are leguminous trees, and shrubs, fruit trees and browse plants. Goats, sheep and poultry are commonly kept for sale and for domestic consumption. Traditional farming practices include a combination of crop husbandry and small livestock. Each farm family keeps an average of 3 goats, 2 pigs and 5 fowls. Goats and sheep may range freely depending on the crop season. Fowls range freely while pigs are raised in pens. Livestock are fed with fodder from trees and shrubs, crop residues, grasses and herbaceous species growing in the compound farms and the woodlots. The woodlots are outlying fields. Eucalyptus woodlots are planted on hill tops while the bottomlands are planted with indigenous trees and possess the spring sources for homesteads (Figure 4).

Table 2: Management of compound farm live fences in selected villages of Bandjoun area

Village (code)	Enclosure with existing hedges	Enclosure with yearly maintenance	Enclosure with only casual maintenance	Enclosure with no maintenance	Hedges replaced with barbed-wire	Hedges replaced with exotic trees	Hedges replaced with cement blocks	Total
A	19	2	3	27	3	3	2	59
B	11	0	2	12	1	0	0	26
C	13	1	3	11	2	2	0	32
D	11	2	7	9	3	0	4	36
E	12	3	6	9	1	2	0	33
F	15	6	9	5	2	0	3	41
G	8	3	4	3	0	1	0	19
Total	89	17	34	76	12	8	8	244
Percentage	36.47	6.96	13.93	31.14	4.91	3.27	3.27	100

Table 2 presents data on the management of hedge enclosures of the compound farm. The table shows that 31.1% of live fences are not maintained, 13.1% of live fences are not maintained, 13.9% receive only casual maintenance, 4.9% have been replaced with barbed-wire, 3.2% replaced with exotic trees (eucalyptus and cypress) and 3.2% replaced with cement block fences. Only 6.9% receive yearly maintenance. The compound farms of the Bamileke plateau are under increasing pressures. Although the present system has remained relatively stable over the years, the present population pressure and the scarcity of land are putting increasing pressure on it. Only 36.4% of compound farms are totally enclosed by live fences. With increasing monetarisation of the traditional economy and the necessity to meet farm family basic needs, the emphasis of land use is turning to current productivity as opposed to sustainable productivity (Faha, 1999). The main Woody species used in live fencing which are now threatened are presented in Table 3. Most of these indigenous trees are refuged in the gallery forests of the highlands. They are planted in live fences through cuttings.

These plants species are rapidly being replaced in woodlots and live fences by exotic species. The gallery swamp forest refugia dominated by *Raphia* species are also rapidly being degraded (Dongmo, 1986).

Table 3: Woody species recorded in live fences and hedgerows of the Bamileke plateau

No	Woody species in live fences	Other functions uses
1	<i>Caesalpinia sp.</i>	Soil conversation, watershed protection
2	<i>Cassia siamea</i>	Fodder, fuelwood, agroforestry
3	<i>Cordia sp.</i>	Fodder, medicinal, carving wood, fuelwood
4	<i>Croton macrostachyus</i>	Shade, timber, watershed protection
5	<i>Crassocephalum manni</i>	Fodder, agroforestry, fuelwood
6	<i>Dracaena sp.</i>	Traditional/ritual uses, boundary demarcation, erosion control
7	<i>Daniella oliveri</i>	Agroforestry, fuelwood
8	<i>Datura candida</i>	Fuelwood
9	<i>Entanda abyssinica</i>	Fodder, fuelwood, erosion control, agroforestry, watershed protection
10	<i>Erythrina sigmoides</i>	Medicinal, fodder, N-fixation
11	<i>Embelia schimperi</i>	Fuelwood, medicinal
12	<i>Ficus spp.</i>	Fuelwood, erosion control, boundary demarcation, ritual/traditional uses, fuelwood
13	<i>Gmelina arborea</i>	Shade
14	<i>Leucaena leucocephala</i>	Fodder, medicinal, fuelwood, N-fixation, reduces soil acidity
15	<i>Maesopsis eminii</i>	Shade, timber, traditional/ritual uses
16	<i>Markhamia tomentosa</i>	Erosion control, medicinal, timber
17	<i>Schefflera barteri</i>	Medicinal, meliferous plant
18	<i>Schezolobium sp.</i>	Erosion control, fuelwood
19	<i>Terminalia sp.</i>	Erosion control, fuelwood, shade, timber
20	<i>Vernonia sp.</i>	Edible leaves, erosion control

Within the compound farm the spatial arrangement of annual and tree crops is typically random. Random mixtures have no specific pattern and

often being the “arrangement” associated with shifting cultivation when trees are the result of random natural regeneration (seedlings and sprouts) rather than of systematic planting. The random arrangement is generally enclosed by border plantings or live fences (Table 3). The live fence encloses random stands of shrubs, biennials and crops. Border planting of trees is practised when short-statured crops cannot stand shading and where these crops are often of prime importance. The trees serve as boundary markers, as live fences and as fire and wind breaks; in addition, the trees have other uses. The compound farm or home garden contains permanent combinations of annual crops, perennial food crops and forest trees with crown levels (multi-storey) – similar to a natural forest (Table 4). The striking feature of the compound farm is the continuous economic and environmental role of diversity of trees: they provide food for people, animal fodder, fuelwood, building materials, and “leaf manure”; at the same time, they stabilize and revitalize the soil. Farmers in the plateau have used this method for hundreds of years (Tamura, 1986) without any detrimental effects on the productivity of the land. The diversity of species account for stability of the system.

Table 4: Woody species recorded in compound farms in the Western Highlands

No	Species	Propagation	Coppicing	Observations / Uses
1	<i>Acacia mearnsii</i>	Seedling	Yes	Fire resistant, erosion control, agroforestry, fuelwood, for restoration of landslides scars
2	<i>Albizia adianthifolia</i>	Seedling + direct seedling	Yes	Fodder, agroforestry, erosion control, fuelwood, fire resistant, watershed protection
3	<i>Albizia gummifera</i>	Seedling + direct seedling	Yes	Fodder, agroforestry, erosion control, fuelwood, fire

				resistant, watershed protection
4	<i>Albizia zygia</i>	Seedling + direct seedling	Yes	Fodder, agroforestry, erosion control, fuelwood, fire resistant, watershed protection
5	<i>Caesalpinia</i>	Seedling + direct seedling	Yes	Fodder, agroforestry, erosion control, fuelwood, fire resistant, watershed protection
6	<i>Canarium siemea</i>	Seedling	No	Local fruit, shell, timber, not good on steep slopes, watershed protection, resin.
7	<i>Cassia siemea</i>	Seedling	Yes	Fuelwood, poles, melliferous, agroforestry
8	<i>Cassia spectabilis</i>	Seedling	Yes	Fodder, agroforestry, erosion control, watershed protection
9	<i>Cordenia torrufolia</i>	Seedling	?	Fodder, watershed protection
10	<i>Cordia milleney</i>	Seedling + direct seedling	Yes	Fodder, watershed protection, poles, timber
11	<i>Cola acuminate</i>	Seedling	No	Nuts, enrichment planting in

				watersheds and fields
12	<i>Croton macrostachyus</i>	Seedling	Yes	Live fence, shade, timber, poles, fodder, agroforestry, erosion control, watershed protection
13	<i>Cordia africana</i>	Seedling + direct seedling	Yes	Fodder, live fence, erosion control, fuelwood, watershed protection, timber
14	<i>Cmellina sp.</i>	Seedling	?	Live fence, erosion control, fuelwood, timber
15	<i>Crassocephalum mannii</i>	Seedling	?	Fodder, agroforestry, live fence, fuelwood
16	<i>Dracaena sp.</i>	Cutting/direct seedling	Yes	Live fence, stabilization of gully banks and landslides scar restoration, fire resistant
17	<i>Daniellia oliveri</i>	Seedling	?	Fodder, agroforestry, erosion control, watershed protection, fuelwood, timber, fire resistant
18	<i>Etanda africana</i>	Seedling	Yes	Fodder, agroforestry, live fence, erosion control, fuelwood, fire resistant, slow

				growth
19	<i>Etanda abyssinica</i>	Seedling	Yes	Fodder, agroforestry, life fence, erosion control, fuelwood, fire resistant, slow growth
20	<i>Erythrina sigmoides</i>	Cutting + seedling	Yes	Live fence, agroforestry, fodder, erosion control, watershed protection, fire resistant, contour wattle
21	<i>Ficus ovata</i>	Cutting + seedling	Yes	Live fence, agroforestry, fodder, erosion control, watershed protection, fire resistant, contour wattle
22	<i>Ficus glumsa</i>	Cutting + seedling	Yes	Live fence, agroforestry, fodder, erosion control, watershed protection, fire resistant, contour wattle
23	<i>Ficus vogelianm</i>	Cutting + seedling	Yes	Live fence, agroforestry, fodder, erosion control, watershed protection, fire resistant, contour wattle

24	<i>Leucaena L.</i>	Seedling + direct seedling	Yes	Agroforestry, erosion control, fuelwood, watershed protection
25	<i>Gmelina arborea</i>	Seedling	?	Live fence, starter tree (pioneer). Good for landslides scar restoration
26	<i>Grevillea rubosta</i>	Seedling	No	Melliferous, shade, rapid growth
27	<i>Khaya grandis</i>	Seedling	Yes	Reforestation of slopes, shade, timber, landslides scar restoration
28	<i>Lasiosiphongl aucus</i>	Seedling	Yes	Reforestation, shade, timber, watershed protection
29	<i>Maesa lanceolata</i>	Seedling	?	Agroforestry, erosion control, timber
30	<i>Maesopsis emini</i>	Seedling	Yes	Shade, timber, watershed protection
31	<i>Markhamia tomentosa</i>	Seedling	Yes	Live fence, erosion control, timber, watershed protection
32	<i>Mimosa scabrella</i>	Seedling	Yes	Pioneer tree. Good for landslides scar restoration, watershed protection
33	<i>Newtonia buchananii</i>	Seedling	Yes	Rapid growth, reforestation, good for landslide

				scar restoration
34	<i>Piliostigma thoningii</i>	Seedling	?	Fodder, erosion control, fuelwood, timber
35	<i>Podocarpus milanjanus</i>	Seedling	No	Reforestation of unstable moderate slopes, timber, watershed protection
36	<i>Polyscias fulva</i>	Seedling	?	Reforestation, melliferous, timber, watershed protection
37	<i>Prunus africanus</i>	Seedling	Yes	Reforestation of unstable moderate slopes, watershed protection, timber
38	<i>Pseudospodia microcarpa</i>	Seedling	?	Fodder, erosion control/slope stabilization, fuelwood
39	<i>Raphia vinifera</i>	Seedling	No	Wine, furniture, landslide scar stabilization, watershed protection
40	<i>Schizotobium</i>	Seedling	?	Erosion control, agroforestry, fodder, live fence, fuelwood
41	<i>Sesbania macrantha</i>	Seedling	No	Fodder, agroforestry, erosion control, fuelwood
42	<i>Sorindeia sp.</i>	Seedling	Yes	Reforestation of potential creep

				slopes, shade, timber, melliferous, watershed protection
43	<i>Spathodea sp.</i>	Seedling	Yes	Reforestation of potential creep slopes, shade, timber, watershed protection
44	<i>Terminalia sp.</i>	Seedling	?	Reforestation of potential creep slopes, shade, timber, watershed protection, fire resistant
45	<i>Tephrosia vogeli</i>	Seeds	No	Fodder, agroforestry, erosion control, watershed protection, rapid growth, pioneer plant for landslides scar restoration
46	<i>Trema orientalis</i>	Seedlings/cuttings	?	Restoration of degraded slopes, shade, timber, watershed protection
47	<i>Vitex diversifolia</i>	Seedling	?	Agroforestry, fuelwood
48	<i>Vernonia sp.</i>	Cuttings /seedlings	Yes	Pioneer plant, good for landslide scar restoration, rapid growth, fire resistant, edible leaves

Source: Asab, 1994; Zimmermann, 1996; Ndenecho, 2006

There are four general categories of products obtained from the compound farm:

- Tree products: firewood, poles, gums, medicinal products
- Perennial cash or subsistence crops: fruits, nuts fibres
- Staple food crops: cocoyam, colocassia, maize, pumpkins, sweet potatoes, groundnuts, yams.
- Forage and mulch: leaves of trees and grasses under the trees, house refuse.

The age-old stability of the compound farm is today threatened by the following:

- Soil tillage practices have remained traditional for centuries. This has resulted in degradation and poor yields.
- It is perceived as a primitive form of subsistence land use. This view has resulted in little, if any, resources devoted to its study and improvement;
- There is rapid replacement of indigenous tree and shrub species with rapid growing exotic species such as the eucalyptus and the cypress. This has adverse effects on soil and water resources;
- The drainage and utilization of valleys (swamp forests) is eroding the native species of trees and shrubs – especially the raffia palms (*Raphia sp.*). A consequence is that many spring sources are drying up; and
- Urbanization and access to markets have induced the conversion of compound farms to market gardens and monoculture of cash crops dependent on high external inputs.

On the other hand, the compound farm is a viable and sustainable farming system appropriate for the humid tropics. Due to demographic pressure, it is subject to stresses despite the merits of the system:

- Naturally, a variety of foods are available to the farm family throughout the year. It minimizes the risk of crop failure;
- It reduces the problems of food preservation and storage common in the humid tropics;
- Farm labour is evenly distributed throughout the year, although there may be some idle months;
- The multistoried system maximizes incipient sunlight necessary for photosynthesis. The majority of crops are shade tolerant; and
- It optimizes nutrient availability and cycling.

Conclusion

Due to the high rate of forest clearance in the area, a large number of potentially valuable species are currently being lost. Current agroforestry research programmes must emphasize the production of seedlings of these multipurpose species in the short term. In the long term, exploitation of variations in phenology both within and between species could result in longer term or all year round availability of desired vegetables, fruits or useful plant organs. Similarly, intensive selection methods could result in increased yields and quality of products. There is also need for the screening of multipurpose trees/shrub species for valleys. A well coordinated and systematic research programme is required to obtain information relevant to enhancing the productivity and sustainability of the compound farm system. Local government agencies and non-governmental organizations are already collecting species of interest to soil fertility maintenance. There is need for scientists, government agencies and non-governmental organizations to collaborate with farmers in trying to improve the selection, conservation, and distribution of genetic resources so that valuable indigenous knowledge about genetic resource management can be tapped and kept alive. The concept of the compound farm system as multipurpose gene banks requiring little inputs but enjoying protection by farmers who derive benefits from the system, may be the only way to minimize the current genetic erosion occurring in tropical montane forest ecoregions.

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Summary

Developing countries possess a wealth of indigenous knowledge on plants. This knowledge has since colonisation been on a downward spiral to a decline due to the bias in the demand for plant resources by Europeans. The research and development of genetic resources favoured the interest of colonial masters. After independence the demand for foreign exchange continued to be biased towards the production of few crops. It is now evident that tropical forest offer opportunities for new genetic resources. The concluding chapter examines the main problems in the development of these indigenous plant resources. These problems include biogenetic erosion, conservation issues, bioprospection and biopiracy and biological and physical stresses resulting from human-related and climate-related environmental processes. It finally identifies the sustainable development path for indigenous plants.

Key Words: Indigenous plants, indigenous knowledge, genetic resources, active ingredients, biopiracy, bioprospection.

Introduction

The biological and agricultural diversity of the afro-montane eco-region is crucial to sustaining human livelihoods. This is why we must strive to maintain and conserve these indigenous plant resources. The foregoing chapters demonstrate that poor people in developing countries are particularly dependent on continued biodiversity. The great wealth of plants and animal species is the basis for their livelihoods, their food supply and – through medicinal plants – their health.

Article 2 of the Convention of Biological Diversity (CBD) of the United Nations (UN) defines biological diversity quite prosaic as “the variability among living organisms from all sources, including *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, this include diversity within species and ecosystems”. It is the term given to the variety of life on earth. It is the combination of life forms and their interactions with one another, and with the physical environment that has made earth habitable for humans. Ecosystems provide the basic necessities for life, offer protection from natural disasters, and disease, and

are the foundation for human culture. CBD calls for biodiversity to be protected and used sustainably and for the benefits arising from such use to be shared equitably. This convention is the first multi-lateral agreement to combine environmental and development goals. It thus seeks to ensure that developing countries benefit from the use of their biodiversity, for example, when new pharmaceutical products are developed.

This chapter examines the major concerns in the development of indigenous plants and indigenous knowledge systems in developing, traditional societies. It finally identifies the sustainable development path and the scope for cooperation at international level to enhance benefits and the productivity of these genetic resources.

Concerns about Biodiversity Loss

The services provided by a healthy and biodiverse ecosystem are the foundation for human well-being. However, out of the 24 ecosystem services assessed by the Millenium Ecosystem Assessment, 15 are in decline. These include the provision of freshwater, marine fishery production, the number and quality of places of spiritual and religious value, the ability of the atmosphere to cleanse itself of pollutants, natural hazard regulation, pollination and the capacity of agricultural systems to provide pest control.

Major causes for the continuing loss of species diversity are destructive extraction, over-exploitation, land use change, climate change and the suppression of native species by newly introduced invasive species. There is often insufficient incentive to use biological diversity sustainably, for example, managing a forest sustainably rather than cutting it down. The increasing industrialisation of agriculture also takes place at the expense of biodiversity. Agricultural subsidies, natural disasters and wars contribute too, to the disappearance of plants and animals.

There is need to awaken political will to halt biodiversity loss and ecosystem degradation. There is an urgent need to clearly demonstrate to policy makers and society at large the full contribution made by biodiversity to poverty alleviation efforts and national economic growth. Decision on the conservation and use of biodiversity must involve the population of the communities concerned. This is important because people will not accept conservation measures and regulations unless they have a fair share in the profits arising from the use of their biodiversity.

Using Native Plants to Alleviate Hunger

Native fruits and vegetables are a largely untapped resource that could combat malnutrition and boost environmental stability and rural development in Sub-Saharan Africa. Science institutes, policy makers, nongovernmental organizations and individuals could all use modern horticultural knowledge and scientific research to bring these “wild crops” to their full potential. If this is not done, the native species will continue their downward spiral of dwindling knowledge. Decreasing biodiversity may be related to reduced food security as varying conditions resulting from anthropogenic stresses and climate change – related stresses cannot always be buffered by genetic or species diversity. The risk of famine increases with climate change, particularly when agricultural systems and livelihood options rely on few or only one species and institutions cannot provide support.

Many smallholders exploit wild plants. Information on these indigenous genetic resources is sketchy, but the foregoing chapters demonstrate that they play a critical role in meeting the needs of local people. Indigenous plants provide diverse foods and products that can be vital during famines. They can also provide many useful nonfood products and sources of income. As they often grow on marginal land or form part of multiple cropping systems, exploiting indigenous plants increases land use efficiency.

Enhancement of Genetic Diversity

The domestication and introduction of under-utilized plant genetic resources into local farming systems allows for local adaptation processes. These valuable genetic resources have been conserved and even improved by indigenous people in some cases. Modern agricultural science has given attention to only a small fraction of the genetic resources useful for sustaining human life. Many plant species that are collected are not known to formal science. *In Situ* conservation is gaining popularity, particularly among NGOs as a farmer-oriented approach to domestication and seed supply. The approach involves establishing seed banks and breeding programmes. There is an urgent need to strengthen community-based systems of conserving local genetic resources and local knowledge about them.

Promotion of Women as Managers of Knowledge on Indigenous Plants

Women possess traditional knowledge and skills in managing natural resources. The most important component of the “survival economy” of

women is their knowledge of wild indigenous vegetables, edible fruits and tubers, and ways of processing and conserving them. In most communities, in the dry season or during severe drought years, the women gather wild fruits and vegetables (*Amaranthas spp.*, and *Vigna spp.*) to feed their families. The berries and leaves are usually eaten fresh, but some are systematically cultivated and preserved for periods of scarcity. These indigenous plants are important genetic resources for sustainable land use systems, as they are resistant to drought and diseases, do not need special fertilizers, may have high nutritional value and can be used not only for food but also for medicines, fodder, fuel, dyes and fibres.

Supporting farmers in domesticating and cultivating their locally adapted native plants is an important insurance against future increase of temperature variation and the occurrence of new pests and diseases. Women possess a rich indigenous knowledge base on these plant resources and must constitute major partners in domestication programmes. Women as food crop farmers can pioneer this process through the introduction of useful trees in integrated farm systems. By selecting and adapting appropriate techniques and genetic resources, rural development workers can design integrated systems for various biophysical and socio-cultural settings. Such integrated farm systems can provide farm families with many of their daily needs: a variety of nutritious foods, wood for building and cooking, spices, fruits, vegetables, medicines and various other products for home use, and cash for the things the farm cannot provide.

Achieving A More Efficient and Balanced Exploitation of Native Plants

The government, technical assistance personnel and researchers in agriculture, and related disciplines must seek to help local people achieve a more efficient and balanced exploitation of their biological resources. The aim of research should focus on the following:

- To identify neglected but seemingly useful plants, both wild and domesticated, that have economic potential;
- To select the plants that showed the most promise for wider exploitation throughout the ecoregion and similar regions in the tropics; and
- To indicate requirements and avenues for research to ensure that identified and selected plants reach the fullest potential.

Plants chosen for such a development programme must satisfy several criteria, the most important of which are:

- The plants must have a significant potential as a source of food, forage, fibre or industrial raw material;
- It can be capable of making local communities more productive;
- Must be able to make a specific contribution to human nutrition; and
- Should have multiple properties enabling several useful products to be obtained.

The above considerations are particularly important because we have just begun to take stock of the chemical and genetic possibilities of plants in the country. There is need to scrutinize the thousands of plant species, many of which are still untested and some as yet unidentified.

The apparent advantages of staple plants over minor plants collected from the wild often results only from the disproportionate research attention they have been given. Many indigenous species may possess equal merit, but were disregarded during the colonial era when consumer demands in European countries largely determined the cultivation and research priorities in tropical agriculture. The crops selected such as oil palm, rubber, banana, pineapples, tea, coffee, groundnuts and coconuts received considerable research and extension. Even after independence, the pattern of concentrating on a few crops changed little. Markets were established and the newly independent tropical countries needed foreign exchange. Furthermore, as indigenous scientists were generally trained in the institutions of temperate – zone countries they had little interest in studying tropical plant species. Even the food preference of local populations in tropical colonial countries became so influence by European food habits that in many places local demand for traditional food crops declined.

Because of the above factors, the potential of many tropical plants collected from the wild and cultivated crops has never been explored. Most agricultural scientists are unaware of the scope and potential offered by tropical botany. The discipline suffers mainly because the major centres of scientific research are located in temperate zones. There is an urgent need for plant researchers to become acquainted with tropical plant life. Important new products such as oils, gums, and waxes for industry; proteins for food and feed, medicines and chemicals for pest control – are likely to result from their attention. New materials will also be required in future. Changing conditions are already creating demands for new products from previously underexploited tropical plants; more will be needed as pressure increases for the exploitation of renewable resources:

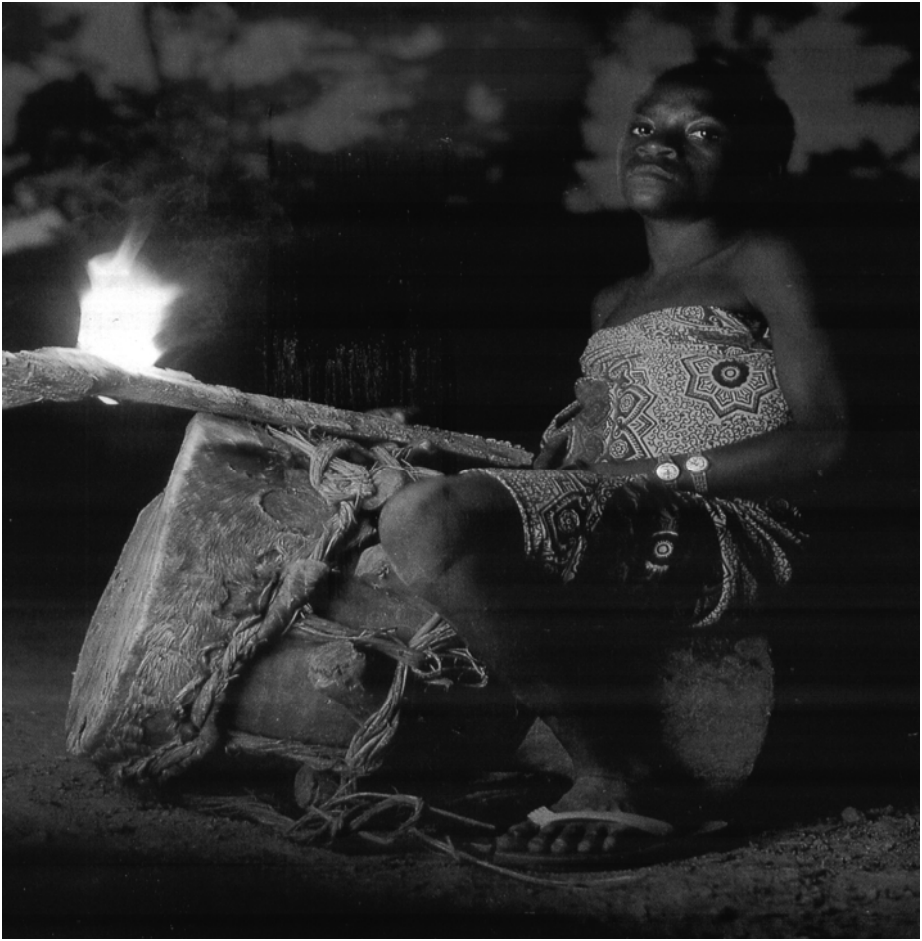


Photo: In the rainforest area, a girl dispels darkness in the traditional way: burning gum from a local tree. Oils from tropical plants may become more widely used as sources of energy.

- Innovations in transportation already make it feasible to transport perishable products around the world.
- Affluence in certain parts of the world has enhanced the consumer's ability to pay for speciality items and heightened his desire for new products such as spices, that are grown in tropical areas.
- Burgeoning populations and continued poverty in tropical countries, and the increased need for survival has heightened the interest to exploit and market native plants of economic interest.

- Improved scientific knowledge of the adverse effects of certain products has created demands for new products, including biomedicine, unsaturated fats, low caloric sweeteners, and biodegradable pesticides.

- New industrial processes have stimulated the need for larger supplies of materials such as elastomers, lubricating oils, drug-precursors, and waxes.

Tropical plants growing in the wild appear to meet many of these demands. Given concentrated research, many underexploited tropical plants could follow the development course of rubber (*hevea*) or oil palm (*Elaies guineensis*).

Prospection and Collection of Indigenous Plants

Genetic resources are the starting materials for biotechnology processes and are particularly needed in the pharmaceutical and cosmetic industry and in the plant breeding sector. Research institutions and companies can generally have active ingredients far more easily when they can draw on the existing traditional knowledge of local communities. For example, the use made of plants in traditional medicine, and the ways they are prepared, provide viable indications as to what active substances these plants contain.

There is mounting public controversy over cases in which companies or research institutions based in the developed countries make use of active ingredients extracted from plants or animals native to developing countries in order to make new pharmaceutical or cosmetic products. To safeguard promising finds of such active substances, companies frequently seek to obtain patents in the developed countries. In this context the term “biopiracy” inevitably comes up. Biopiracy is a term used since 1993. it means the wrongful appropriation (usually through patenting) of intellectual property rights to biologically active ingredients or to knowledge associated with the utilization of genetic resources. Such appropriation of property rights is considered wrongful if those applying for the patent have not themselves engaged in innovative activity. However, representatives of indigenous groups and traditional communities maintain that biopiracy is not constituted just at the stage of patenting an active ingredient. They consider that searching for and collecting genetic resources (plants, animals, micro-organisms) is already biopiracy if it takes place without the prior informed consent of the local communities concerned.

The term biopiracy is thus used at two different levels and with different meanings. This causes some confusion. Moreover, it hampers efforts to control biopiracy through international agreements such as the Convention on Biological Diversity (CBD) or the FAO International Treaty on Plant

Genetic Resources for Food and Agriculture. The CBD, signed in 1992 at the Rio de Janeiro Earth Summit, requires in Article 8j that the contracting parties apply their national legislation to protect the knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles and to encourage equitable sharing of the benefits arising from the utilization of such knowledge.

What some view negatively and deem to be biopiracy, is for others merely bioprospection: the search for active ingredients in plants, animals and micro-organism, and thus a necessary precondition to achieving another goal of the CBD – the sustainable use of genetic resources. In many cases the question of how to implement a purposeful benefit – sharing system in conformity with the CBD remains unresolved. Consequently, in order not to expose themselves to international criticism and accusations of biopiracy, some pharmaceutical and chemical companies prefer to do entirely without the traditional knowledge of local communities. Instead, they engage in random screening: a systematic search for active substances in organisms. This approach overlooks the fact that, through their lifestyles and their knowledge about their habitats, local communities contribute to the conservative of species and can thus claim a share in the benefits in any case.

In principle, claims to shares in the profits arising can be sued for in court. However, local communities can only in the rarest instances afford such costly undertaking with an uncertain outcome. Thus in effect financially well-endowed companies from industrialized countries are often free to do as they choose. Developing countries view this as a modern form of colonialism, that is, “bio-colonialism”.

In April 2002, the 6th Meeting of the Conference of the Parties (COP 6) to the CBD adopted the Bonn Guidelines on Access to Genetic Resources and Benefit – Sharing. Many developing countries take the view that this voluntary approach will not suffice to prevent biopiracy effectively. They therefore call for the establishment of an international regime which ensures that the users of genetic resources give the countries of origin a share in the benefits. Upon the insistence of the developing countries, this demand has been included in the plan of implementation adopted at the Johannesburg summit.

Mountain forests provide important ecological services, and essential products. This book focuses on the importance of mountain forests in Cameroon for the local people who depend most directly on them, and have often developed a wealth of indigenous knowledge on plants and sophisticated institutions for managing limited plant and animal resources. Such knowledge and institutions have often been threatened, or even destroyed, by centralization and globalization; yet there is increasing recognition that community-based institutions are the best adapted to ensuring that mountain forests continue to supply their diverse goods and services to both mountain and other people over the long-term. The book provides a useful combination of case studies on ethnobotanic analysis and cultural values of plants, community-based ecological planning for protected area management and eco-cultural tourism development. It provides an unusually useful combination of overviews and synthesis of theory and experience with in-depth case studies of montane forest-adjacent communities and protected areas. Throughout the book there are good summary tables, case study maps, and diagrams that are relevant to the themes in question. Finally, the book addresses the possible mutual benefits of indigenous knowledge and modern science, indigenous peoples and the development of eco-cultural tourism in protected areas, indigenous peoples and ecological planning in protected areas. It therefore emphasizes cooperation based on partnerships amongst indigenous people, governments and the global conservation community, in the interest of effective conservation. This is a valuable book for land managers, environmental scientists, environmental biologists, natural resource managers and students reading subjects such as geography, biology, forestry, botany and environmental science.

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